PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-093672
(43)Date of publication of application : 10.04.1998

(51)Int.Cl. H04M 1/03
B06B 1/04
H04M 1/00
H04R 1/00

(21)Application number : 09-108875
(22)Date of filing : 25.04.1997

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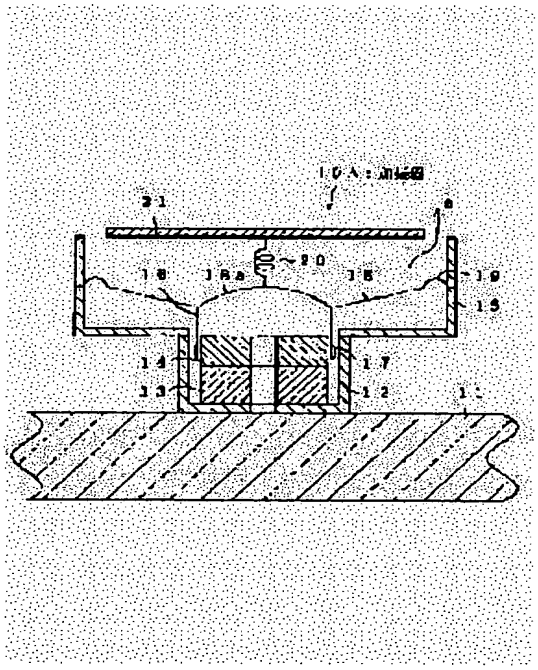
(30)Priority
Priority number : 08130986 Priority date : 25.04.1996 Priority country : JP

(54) OSCILLATOR, OSCILLATION DEVICE, AND PORTABLE TERMINAL EQUIPMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To realize an oscillator which is operated as an oscillator with a high frequency and is operated as a sound producer with a high frequency by coupling a load mass to a diaphragm through a compliance.
SOLUTION: A magnetic circuit part consisting of a yoke 12, a magnet 13, and a center pole 14 is provided as a fixed part in the same manner as a speaker, and a voice coil bobbin 16 around which an excitation coil 17 is wound and a diaphragm 18 are provided as a mobile part. A load mass 21 is attached to the center of the diaphragm 18 through a spring 20. When the diaphragm 18 is oscillated with a low frequency, the spring 20 acts as a compliance, and a frame 15 receives a repulsion by the inertia of the load mass 21 and is oscillated. When a signal in a sound band is inputted, it functions as a speaker, and sounds are outputted from the front.



LEGAL STATUS

[Date of request for examination] 19.01.1998

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]	2937939
[Date of registration]	11.06.1999
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The diaphragm which vibrates with low frequency and a speech frequency band at least, and the excitation coil attached in said diaphragm through the bobbin, said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force, and the inertial load which has predetermined mass When the compliance prepared between said diaphragms and said inertial loads is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, The shaker characterized by said diaphragm vibrating by said compliance and making it pronounce when said inertial load and said diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil.
[Claim 2] Said compliance is a shaker according to claim 1 characterized by being the spring connected to said diaphragm and said inertial load.
[Claim 3] The 1st diaphragm which vibrates with low frequency and a speech frequency band at least, and the excitation coil attached in said 1st diaphragm through the bobbin, said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force, and the 2nd diaphragm which is held free [vibration] to the frame which supports said 1st diaphragm, and has a resonant frequency lower than said 1st diaphragm When the compliance prepared between said 1st diaphragm and said 2nd diaphragm is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, The shaker characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce when said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil.
[Claim 4] Said compliance is a shaker according to claim 3 characterized by being the air chamber sealed with said the 1st diaphragm, said 2nd diaphragm, and said frame.
[Claim 5] The diaphragm which vibrates with low frequency and a speech frequency band at least, and the excitation coil attached in said diaphragm through the bobbin, said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force, and the inertial load which has predetermined mass With the mechanical transformer which changes the mass of said inertial load through vibration system, and the compliance prepared between said diaphragms the primary said mechanical transformer side When it provides and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, The shaker characterized by said diaphragm vibrating by said compliance and making it pronounce when said inertial load and said diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil.
[Claim 6] Said compliance is a shaker according to claim 5 characterized by being said spring connected with the diaphragm at the primary said mechanical transformer side.
[Claim 7] Said mechanical transformer is a shaker according to claim 5 characterized by being the lever which has the supporting point in the frame which said compliance is attached in an end, and said inertial load is attached in the other end, and supports said 1st diaphragm.
[Claim 8] The 1st diaphragm which vibrates with low frequency and a speech frequency band at least, and the excitation coil attached in said 1st diaphragm through the bobbin, said excitation coil -- electromagnetism -- it being held free [vibration] to the magnetic circuit which gives driving force, and the frame which supports said 1st diaphragm, and with the 2nd diaphragm with an effective area smaller than said 1st diaphragm When the compliance prepared between said 1st diaphragm and said 2nd diaphragm is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, The shaker characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce when said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil.
[Claim 9] Said compliance is a shaker according to claim 8 characterized by being the air chamber sealed with said the 1st diaphragm, said 2nd diaphragm, and said frame.

[Claim 10] Said 2nd diaphragm is a shaker according to claim 9 characterized by being what constitutes the acoustical transformer which increases the oscillating load of said 1st diaphragm through said air chamber.
[Claim 11] The 1st diaphragm which vibrates with low frequency and a speech frequency band at least, and the excitation coil attached in said 1st diaphragm through the bobbin, said excitation coil -- electromagnetism -- it being held free [vibration] to the magnetic circuit which gives driving force, and the frame which supports said 1st diaphragm, and with the 2nd diaphragm with an effective area smaller than said 1st diaphragm With the compliance prepared between said 1st diaphragm and said 2nd diaphragm When the mass of the inertial load which has predetermined mass, and said inertial load is changed through vibration system, the mechanical transformer which gives a conversion load to said 2nd diaphragm is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, The shaker characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce when said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil.
[Claim 12] Said compliance is a shaker according to claim 11 characterized by being the air chamber sealed with said the 1st diaphragm, said 2nd diaphragm, and said frame.
[Claim 13] Said mechanical transformer is a shaker according to claim 11 characterized by being the lever which has the supporting point in the frame which said compliance is attached in an end, and said inertial load is attached in the other end, and supports said 1st diaphragm.
[Claim 14] The 1st diaphragm which vibrates with low frequency and a speech frequency band at least, and the excitation coil attached in said 1st diaphragm through the bobbin, said excitation coil -- electromagnetism -- it being held free [vibration] to the magnetic circuit which gives driving force, and the frame which supports said 1st diaphragm, and with the 2nd diaphragm with an effective area smaller than said 1st diaphragm The 1st air chamber which was prepared between said 1st diaphragm and said 2nd diaphragm, and was sealed, When input the aerial vibration generated in said 1st air chamber, it is made to pile up, the 2nd air chamber which makes aerial vibration output outside through tubing is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, The shaker characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce when said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil.
[Claim 15] Excitation equipment characterized by providing the electrical signal generator which inputs into said shaker an electrical signal with the predetermined frequency bandwidth which contains the resonance frequency of vibration at least as a shaker according to claim 1 to 14.
[Claim 16] Excitation equipment characterized by providing a shaker according to claim 1 to 14 and the electrical signal generator which inputs into said shaker the electrical signal which carries out the sweep of the frequency in time including the resonance frequency of vibration at least.
[Claim 17] Said electrical signal generator is excitation equipment according to claim 16 characterized by being what generates the sinusoidal signal from which a frequency changes with sweeps.
[Claim 18] Said electrical signal generator is excitation equipment according to claim 16 characterized by being what generates the square wave signal from which a frequency changes with sweeps.
[Claim 19] Excitation equipment according to claim 18 characterized by preparing the low pass filter which makes a frequency lower than the speech frequency reproduced to the output side of said electrical signal generator cut-off frequency.
[Claim 20] Said excitation coil is a shaker of seven claims 1, 2, 5, and 6 and given in any 1 term characterized by driving with the excitation signal of the predetermined bandwidth containing the resonance frequency of said inertial load.
[Claim 21] Said excitation coil is a shaker of 8-14 claims 3 and 4 and given in any 1 term characterized by driving with the excitation signal of the predetermined bandwidth containing the resonance frequency of said 2nd diaphragm.
[Claim 22] Said excitation coil is a shaker of seven claims 1, 2, 5, and 6 and given in any 1 term characterized by driving with the excitation signal by which a sweep is carried out in the predetermined range containing the resonance frequency of said inertial load.
[Claim 23] Said excitation coil is a shaker of 8-14 claims 3 and 4 and given in any 1 term characterized by driving with the excitation signal by which a sweep is carried out in the predetermined range containing the resonance frequency of said 2nd diaphragm.
[Claim 24] Claims 1-14, personal digital assistant equipment characterized by providing the shaker of 20-23 given in any 1 term.
[Claim 25] Personal digital assistant equipment characterized by providing the excitation equipment of claim 15-19 given in any 1 term.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the personal digital assistant equipment furnished with the shaker, the excitation equipment and the shaker, or excitation equipment which has a pronunciation function.
[0002]
[Description of the Prior Art] An example of the conventional electrodynamic type shaker is explained. Drawing 14 is the sectional view showing the structure of the conventional electrodynamic type shaker, and is constituted including a housing 101, a magnetic circuit 102, the excitation coil 103, an absorber 104, and the voice coil bobbin 105. A housing 101 is the housing of the shaker itself, and a housing which became personal digital assistant equipment in common. Monotonous section 101a is formed in some housings 101. The time volume of the lower limit section is carried out with the excitation coil 103, and the voice coil bobbin 105 is in the condition that the upper limit section fixed to oscillating section 101a of a housing.
[0003] In the electrodynamic type shaker of such a configuration, if the electrical signal of an alternating current is impressed to the excitation coil 103, electromagnetic force will occur between the excitation coil 103 and a magnetic circuit 102, and the voice coil bobbin 105 will vibrate to shaft orientations. The magnetic circuit 102 including the center pole and York is held free [vibration] with the housing 101 down side through the damper 104. For this reason, both a magnetic circuit 104 and the housing 101 vibrate mutually according to the reaction of electromagnetic force. Vibration of a housing 101 is transmitted [shaker / of a through lever / electrodynamic type] to the user who attached to the body in monotonous section 101a.
[0004]
[Problem(s) to be Solved by the Invention] However, in such a conventional electrodynamic type shaker, since resonance sharpness is proportional to the mass of vibration system, in order to acquire the big force near resonance frequency, mass of a magnetic circuit 102 must be enlarged. When carried out like this, there was a fault that the weight of the whole shaker will become very big.
[0005] Moreover, when mass of a magnetic circuit 102 was enlarged, there was a problem that the own vibration of a magnetic circuit becomes small, and were hard coming to generate a sound from a magnetic circuit 102, and effectiveness worsened as the sounding body.
[0006] By being made in view of such a conventional trouble, and minding compliance between the diaphragm of a **** conversion mold, and the load mass made to add to a diaphragm, on a low frequency, this invention is operated as a shaker and aims at realizing the shaker operated as the sounding body with a high frequency. Furthermore, by preparing a transformer, the weight on the appearance of load mass is reduced and it aims at suppressing the increment in weight of the whole shaker.
[0007]
[Means for Solving the Problem] In order to solve such a technical problem, invention of this application according to claim 1 The diaphragm which vibrates with low frequency and a speech frequency band at least, and the excitation coil attached in said diaphragm through the bobbin, said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force, and the inertial load which has predetermined mass When the compliance prepared between said diaphragms and said inertial loads is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said inertial load and said diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is characterized by said diaphragm vibrating by said compliance and making it pronounce.
[0008] Moreover, in invention of this application according to claim 2, said compliance is characterized by being the spring connected to said diaphragm and said inertial load in a shaker according to claim 1.
[0009] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, an inertial load and a diaphragm vibrate to one. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. Moreover, when a

sound signal is impressed,to an excitation coil, only a diaphragm vibrates by compliance and voice is emitted outside. Therefore, both the functions of a shaker and the sounding body are attained by one equipment.
[0010] Moreover, the 1st diaphragm to which invention of this application according to claim 3 vibrates with low frequency and a speech frequency band at least, the excitation coil attached in said 1st diaphragm through the bobbin, and said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force The 2nd diaphragm which is held free [vibration] to the frame which supports said 1st diaphragm, and has a resonant frequency lower than said 1st diaphragm, When the compliance prepared between said 1st diaphragm and said 2nd diaphragm is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce.
[0011] Moreover, in invention of this application according to claim 4, said compliance is characterized by being the air chamber sealed with said the 1st diaphragm, said 2nd diaphragm, and said frame in a shaker according to claim 3.
[0012] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, the 1st diaphragm and 2nd diaphragm vibrate to one. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. When a sound signal is impressed to an excitation coil, only said 1st diaphragm vibrates by said compliance, and voice is emitted outside. Therefore, both the functions of a shaker and the sounding body are attained by one equipment. Local stress does not join the diaphragm of **** 1.
[0013] Moreover, the diaphragm to which invention of this application according to claim 5 vibrates with low frequency and a speech frequency band at least, the excitation coil attached in said diaphragm through the bobbin, and said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force The inertial load which has predetermined mass, and the mechanical transformer which changes the mass of said inertial load through vibration system, When the compliance prepared between said diaphragms the primary said mechanical transformer side is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said inertial load and said diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce.
[0014] Moreover, in invention of this application according to claim 6, said compliance is characterized by being said spring connected with the diaphragm at the primary said mechanical transformer side in a shaker according to claim 5.
[0015] Moreover, in invention of this application according to claim 7, in a shaker according to claim 5, said compliance is attached in an end, said inertial load is attached in the other end, and said mechanical transformer is characterized by being the lever which has the supporting point in the frame which supports said 1st diaphragm.
[0016] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, an inertial load and a diaphragm vibrate to one through a mechanical transformer. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. When a sound signal is impressed to an excitation coil, only the 1st diaphragm vibrates by compliance and voice is emitted outside. Therefore, both the functions of a shaker and the sounding body are attained by one equipment. Moreover, the mass of an inertial load is smaller than the thing of claim 1 and two publications, and ends.

[0017] Moreover, the 1st diaphragm to which invention of this application according to claim 8 vibrates with low frequency and a speech frequency band at least, the excitation coil attached in said 1st diaphragm through the bobbin, and said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force The 2nd diaphragm with an effective area it is held free [vibration] to the frame which supports said 1st diaphragm, and smaller than said 1st diaphragm, When the compliance prepared between said 1st diaphragm and said 2nd diaphragm is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce.
[0018] Moreover, in invention of this application according to claim 9, said compliance is characterized by being the air chamber sealed with said the 1st diaphragm, said 2nd diaphragm, and said frame in a shaker according to claim 8.
[0019] Moreover, in invention of this application according to claim 10, said 2nd diaphragm is characterized by constituting the acoustical transformer which increases the oscillating load of said 1st diaphragm through said air chamber in a shaker according to claim 8.
[0020] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, the 1st diaphragm and 2nd diaphragm vibrate to one through compliance. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. When a sound signal is impressed to an excitation coil, only the 1st diaphragm vibrates by compliance and voice is emitted outside. Therefore, both the functions of a shaker and the sounding body are attained by one equipment. The

diaphragm of **** 2 is good in small area, and local stress does not join the 1st diaphragm.
[0021] Moreover, the 1st diaphragm to which invention of this application according to claim 11 vibrates with low frequency and a speech frequency band at least, the excitation coil attached in said 1st diaphragm through the bobbin, and said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force The 2nd diaphragm with an effective area it is held free [vibration] to the frame which supports said 1st diaphragm, and smaller than said 1st diaphragm, With the compliance prepared between said 1st diaphragm and said 2nd diaphragm When the mass of the inertial load which has predetermined mass, and said inertial load is changed through vibration system, the mechanical transformer which gives a conversion load to said 2nd diaphragm is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce.
[0022] Moreover, in invention of this application according to claim 12, said compliance is characterized by being the air chamber sealed with said the 1st diaphragm, said 2nd diaphragm, and said frame in a shaker according to claim 11.
[0023] Moreover, in invention of this application according to claim 13, in a shaker according to claim 11, said compliance is attached in an end, said inertial load is attached in the other end, and said mechanical transformer is characterized by being the lever which has the supporting point in the frame which supports said 1st diaphragm.
[0024] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, the 1st diaphragm, 2nd diaphragm, and inertial load vibrate to one. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. When a sound signal is impressed to an excitation coil, only the 1st diaphragm vibrates by compliance and voice is emitted outside. Therefore, both the functions of a shaker and the sounding body are attained by one equipment. The diaphragm of **** 2 is good in small area, and local stress does not join the 1st diaphragm. The mass of an inertial load is still smaller than a thing according to claim 5 to 7, and ends.
[0025] Moreover, the 1st diaphragm to which invention of this application according to claim 14 vibrates with low frequency and a speech frequency band at least, the excitation coil attached in said 1st diaphragm through the bobbin, and said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force The 2nd diaphragm with an effective area it is held free [vibration] to the frame which supports said 1st diaphragm, and smaller than said 1st diaphragm, The 1st air chamber which was prepared between said 1st diaphragm and said 2nd diaphragm, and was sealed, When input the aerial vibration generated in said 1st air chamber, it is made to pile up, the 2nd air chamber which makes aerial vibration output outside through tubing is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce.
[0026] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, the 1st diaphragm and 2nd diaphragm vibrate to one through compliance. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. When a sound signal is impressed to an excitation coil, only the 1st diaphragm vibrates by compliance. Since this sound pressure is outputted through tubing combined with the 2nd air chamber Sound pressure level increases more according to an acoustic resonance phenomenon., Moreover, both the functions of a shaker and the sounding body are attained by one equipment. The 2nd diaphragm is still better in small area, and local stress does not join the 1st diaphragm.
[0027] Moreover, invention of this application according to claim 15 is characterized by providing the electrical signal generator which inputs into said shaker an electrical signal with the predetermined frequency bandwidth which contains the resonance frequency of vibration at least as a shaker according to claim 1 to 14.
[0028] Moreover, invention of this application according to claim 16 is characterized by providing a shaker according to claim 1 to 14 and the electrical signal generator which inputs into said shaker the electrical signal which carries out the sweep of the frequency in time including the resonance frequency of vibration at least.
[0029] Moreover, in invention of this application according to claim 17, said electrical signal generator is characterized by generating the sinusoidal signal from which a frequency changes with sweeps in excitation equipment according to claim 16.
[0030] Moreover, in invention of this application according to claim 18, said electrical signal generator is characterized by generating the square wave signal from which a frequency changes with sweeps in excitation equipment according to claim 16.
[0031] Moreover, invention of this application according to claim 19 is characterized by preparing the low pass filter which makes a frequency lower than the speech frequency reproduced to the output side of said electrical signal generator cut-off frequency in excitation equipment according to claim 18.
[0032] Moreover, in invention of this application according to claim 20, said excitation coil is characterized by

driving with the excitation signal of the predetermined bandwidth containing the resonance frequency of said inertial load in the shaker of claims 1, 2, 5, 6, and 7.
[0033] Moreover, in invention of this application according to claim 21, said excitation coil is characterized by driving with the excitation signal of the predetermined bandwidth containing the resonance frequency of said 2nd diaphragm in the shaker of claims 3, 4, 8-14.
[0034] Moreover, in invention of this application according to claim 22, said excitation coil is characterized by driving with the excitation signal by which a sweep is carried out in the predetermined range containing the resonance frequency of said inertial load in the shaker of claims 1, 2, 5, 6, and 7.
[0035] Moreover, in invention of this application according to claim 23, said excitation coil is characterized by driving with the excitation signal by which a sweep is carried out in the predetermined range containing the resonance frequency of said 2nd diaphragm in the shaker of claims 3, 4, 8-14.
[0036] Moreover, with the personal digital assistant equipment of this application according to claim 24, it is characterized by providing the shaker of 20-23 claims 1-14 and given in any 1 term.
[0037] Moreover, with the personal digital assistant equipment of this application according to claim 25, it is characterized by providing the excitation equipment of claim 15-19 given in any 1 term.
[0038] According to such a configuration, the resonance frequency in the excitation mode of a resonator varies, and even if it is, the 1st diaphragm, 2nd diaphragm, or inertial load resonates certainly.
[0039]
[Embodiment of the Invention]
(Gestalt 1 of operation) It explains, referring to drawing 1 about the shaker in the gestalt 1 (the 1) of operation of this invention. Drawing 1 is the sectional view showing the structure of shaker 10A of the gestalt of this operation. This shaker 10A has structure which fixed on the vibrated body 11 which are some housings, has York 12, a magnet 13, a senter pole 14, and a frame 15 as a fixed part, and has the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.
[0040] York 12 was processed in the shape of a cup with the magnetic metal, and along with the medial axis, a disc-like magnet 13 and the disc-like center pole 14 carried out the laminating of it, and have fixed it. Here, a magnet 13 and the center pole 14 have become in midair. The opening which the periphery section of the center pole 14 and the inner circumference section of York 12 form forms a magnetic gap, and the excitation coil 17 by which the time volume was carried out to the periphery section of the voice coil bobbin 16 is held in this magnetic gap.
[0041] The periphery section is formed, the inner circumference section is really formed in the shape of a dome in the shape of a cone, and the diaphragm 18 is held free [vibration] through the edge 19 to the frame 15. If the center section of a diaphragm 18 is set to dome section 18a, the end of a spring 20 has fixed at the core of dome section 18a. And the load mass 21 is attached in the other end of a spring 20 as an inertial load. Furthermore, the voice coil bobbin 16 pastes dome section 18a, and the voice coil bobbin 16 and a diaphragm 18 carry out a piston action to one. If load mass 21 is made into the mass of vibration system, a spring 20 will achieve the function of compliance. The spring 20 in this case is used as the vine volume spring.
[0042] The load mass 21 is plate-like and the path of air is secured spacing the periphery edge of a frame 15, and predetermined. This path is an air duct by which the sound was made to be emitted to the exterior of shaker 10A, when sound pressure occurs by vibration of a diaphragm 18.
[0043] Thus, actuation of shaker 10A of the gestalt 1 of the constituted operation is explained. if an electrical signal is impressed by the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. this time -- electromagnetism -- the reaction force of driving force arises and reaction force is transmitted to the magnetic-circuit section and the frame 15 which are a fixed part in proportion to the acceleration of the diaphragm 18 which is moving part. If the magnetic-circuit section which consists of York 12, a magnet 13, and a senter pole 14 vibrates according to this reaction force, that vibration will get across also to the vibrated body 11.
[0044] The spring 20 which serves as compliance acts as a low pass filter to the load mass 21. When the frequency of the electrical signal impressed to the excitation coil 17 is lower than a speech frequency band, a diaphragm 18 and the load mass 21 are united, and operate. For this reason, near the lowest resonance frequency of shaker 10A, resonance sharpness becomes large and the acceleration of a diaphragm 18 also becomes large. Therefore, since this reaction force becomes large, shaker 10A can vibrate the vibrated body 11.
[0045] When the frequency of the electrical signal impressed as compared with resonance frequency is high (speech frequency band used by telephone etc.), a diaphragm 18 and the load mass 21 are mechanically separated by the spring 20 which is a low pass filter. In this case, since vibrational energy is not transmitted to the load mass 21, a diaphragm 18 vibrates greatly. Sound pressure arises by vibration of this diaphragm 18, and that sound pressure is emitted to outer space from a path like an arrow head a. This condition is actuation as the so-called loudspeaker, and shaker 10A will operate as the sounding body with the usual speech frequency band.
[0046] Next, it explains, referring to drawing 2 about the shaker in the gestalt 1 (the 2) of operation of this invention.

Drawing 2 is the sectional view showing the structure of shaker 10B of the gestalt of this operation. In addition, at shaker 10A shown in drawing 1 , although the magnetic-circuit section is attached in the vibrated body 11, shaker 10B is attached in the sense to which the load mass 21 approaches the vibrated body 11 as shown in drawing 2 R> 2 with the gestalt of this operation. Since each part which constitutes shaker 10B is the same as that of shaker 10A of drawing 1 , explanation of the same part is omitted.

[0047] In this shaker 10B, 2nd path 15a is prepared in the side face of a frame 15. This path 15a is a hole which makes the sound pressure generated by vibration of a diaphragm 18 output outside.

[0048] Actuation of the vibration to the signal of the low frequency in shaker 10B of such a configuration and generating of the sound in a speech frequency band is the same as that of shaker 10A of the structure shown in drawing 1 . That is, if the electrical signal of the frequency of speech frequency is impressed, it will operate as the sounding body and the sound will be emitted outside through path 15a. Moreover, if the electrical signal of a frequency lower than speech frequency is impressed, it will operate as a shaker. Moreover, if both electrical signals are impressed, it will operate to coincidence as a shaker and the sounding body. Thus, a usage can be chosen by the application.

[0049] (Gestalt 2 of operation) It explains, referring to drawing 3 about the shaker in the gestalt 2 of the operation of this invention to a degree. Drawing 3 is the sectional view showing the structure of shaker 10C in the gestalt 2 of operation. In addition, in shaker 10C of the gestalt of this operation, it is the same as that of the gestalt 1 of operation to have York 12, a magnet 13, a senter pole 14, and a frame 15 as a fixed part, and to have the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.

[0050] If a diaphragm 18 is used as the 1st diaphragm, the 2nd diaphragm 22 is formed in the gestalt of this operation. A diaphragm 22 is a diaphragm which vibrates indirectly through the air of a vacant room C, when it is held by 2nd edge 22a free [vibration] to a frame 15 and a diaphragm 18 vibrates by low frequency. The vacant room C said the space surrounded by the side face of diaphragms 18 and 22 and a frame 15, and has achieved the function of compliance to the diaphragm 22.

[0051] Path 15b is prepared in the pars basilaris ossis occipitalis of a frame 15. This path 15b is a hole which makes the sound pressure in the bottom space generated by vibration of a diaphragm 18 output outside. This shaker 10C is attached in the vibrated body 11 through the pars basilaris ossis occipitalis of York 12.

[0052] Actuation of shaker 10C of such a configuration is explained. if an electrical signal is added to the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. The air of the vacant room C which is compliance operates as an acoustical low pass filter to a diaphragm 22. When the frequency of an electrical signal is lower than speech frequency, a diaphragm 18 and the diaphragm 22 combined through the vacant room C are united, and vibrates.

[0053] The frequency of an electrical signal is higher than this, and, in the case of a speech frequency band, it is acoustically separated by the air of the vacant room C a diaphragm 18 and whose diaphragm 22 are low pass filters. Since the energy of a diaphragm 18 is not transmitted to a diaphragm 22 at this time, a diaphragm 18 vibrates greatly. The sound pressure generated with a diaphragm 18 at this time is emitted outside from path 15b like an arrow head b, and a sound gets across to people. Thus, with a speech frequency band, shaker 10C operates as the sounding body.

[0054] Furthermore, with the gestalt of this operation, since a diaphragm 18 and a diaphragm 22 are combined through the air of a vacant room C, when the frequency of an electrical signal is low, the mass of a diaphragm 22 joins homogeneity in the whole field of a diaphragm 18. For this reason, compared with the gestalt 1 of operation, the reinforcement of a diaphragm 18 may not be so strong. Therefore, the ingredient of a diaphragm 18 and the degree of freedom of selection of structure improve.

[0055] (Gestalt 3 of operation) It explains, referring to drawing 4 about the shaker in the gestalt 3 of the operation of this invention to a degree. Drawing 4 is the sectional view showing the structure of shaker 10D in the gestalt 3 of operation. In addition, in shaker 10D of the gestalt of this operation, it is the same as that of the gestalt 1 of operation to have York 12, a magnet 13, a senter pole 14, and a frame 15 as a fixed part, and to have the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.

[0056] The end of a spring 20 is attached in dome section 18a of the diaphragm 18 in the gestalt of this operation. And the load mass 24 is attached in the other end of this spring 20 free [vibration] through the lever 23. Supporting-point 15c is formed in a part of edge of a frame 15 in the shape of knife edge. A lever 23 is a mechanical transformer which makes r2/r1 a transformation ratio, when it is held by supporting-point 15c, die length from supporting-point 15c to the attachment section of a spring 20 is set to r1 and die length from supporting-point 15c to the attachment section of the load mass 24 is set to r2. The power point in this case is in the load mass 24 side, and point of application is in a spring 20 side.

[0057] Actuation of shaker 10D of such a configuration is explained. if an electrical signal is added to the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. If a lever 23 operates as a mechanical transformer and sets mass of the load mass 24 to m, 2 (r2/r1) xm will act as a load of a spring 20.

[0058] The spring 20 which serves as compliance operates as a low pass filter to a lever 23 and the load mass 24. When the frequency of an electrical signal is lower than speech frequency, it is combined with a diaphragm 18 through a lever 23, and the load mass 24 vibrates to one. In this way, shaker 10D vibrates the vibrated body 11.
[0059] The frequency of an electrical signal is higher than this, and, in the case of a speech frequency band, a diaphragm 18 is mechanically separated to the load mass 24 by the spring 20 which is a low pass filter. In this case, since the energy of a diaphragm 18 is not transmitted to the load mass 24 through a lever 23 at this time, a diaphragm 18 vibrates greatly. The sound pressure generated with a diaphragm 18 is emitted outside like an arrow head c. In this way, shaker 10D operates as the sounding body.
[0060] Furthermore, with the gestalt of this operation, since the load mass 24 is combined with a spring 20 through a lever 23, mass m of the load mass 24 can be made small in inverse proportion to the square of a transformation ratio. For this reason, weight of shaker 10D can be made small.
[0061] (Gestalt 4 of operation) It explains, referring to drawing 5 about the shaker in the gestalt 4 of the operation of this invention to a degree. Drawing 5 is the sectional view showing the structure of shaker 10E in the gestalt 4 of operation. In addition, in shaker 10E of the gestalt of this operation, it is the same as that of the gestalt 1 of operation to have York 12, a magnet 13, a senter pole 14, and 1st frame 15A as a fixed part, and to have the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.
[0062] In order to make shaker 10E of the gestalt of this operation open the air chamber of the tooth back of a diaphragm 18 for free passage with the exterior like the gestalt 2 of operation of drawing 3 , 15d of paths is established in the base of frame 15A. On the other hand, unlike the gestalt 2 of operation, 2nd frame 15B is attached in the upper part of frame 15A. Cylinder-like x [opening 15] are formed and, as for the Kaminaka center section of frame 15B, the 2nd diaphragm 25 is attached in this part free [vibration] through edge 25a. In this way, the vacant room C is formed of the space surrounded by the diaphragm 18, frame 15B, and the diaphragm 25.
[0063] Thus, actuation of constituted shaker 10E is explained. Effective area of a diaphragm 18 is set to S1, area of a diaphragm 25 is set to S2, and mass is set to m. if an electrical signal is added to the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. An acoustical transformer can be constituted by making surface ratio (S1/S2) larger than 1. It is called the equivalence load which looked at the value and the multiplication value of the mass m of a diaphragm 25 which carried out the square of a sound transformation ratio, and a call and this ratio for this surface ratio from the diaphragm 18.
[0064] The air of a vacant room C which serves as compliance acts as an acoustical low pass filter to a diaphragm 25. When the frequency of an electrical signal is lower than speech frequency, it combines with a diaphragm 18 through the air of a vacant room C, and a diaphragm 25 vibrates to one. In this case, shaker 10E can operate as a shaker literally, and can vibrate the vibrated body 11.
[0065] The frequency of an electrical signal is higher than this, and, in the case of a speech frequency band, it is acoustically separated by the air of the vacant room C a diaphragm 18 and whose diaphragm 25 are low pass filters. In this case, a diaphragm 18 vibrates greatly and the sound pressure generated from this is emitted outside from 15d of paths like an arrow head d. At this time, shaker 10E operates as the sounding body. Moreover, a diaphragm 18 and a diaphragm 25 are [as opposed to / since it is combined through the air of a vacant room C / a diaphragm 18] 2 xm equivalent (S1/S2). Mass is added. It becomes unnecessary for this reason, to strengthen reinforcement of a diaphragm 18 so much compared with shaker 10A of the gestalt 1 of operation. Therefore, the ingredient of a diaphragm 18 and the degree of freedom of selection of structure improve.
[0066] Furthermore, with the gestalt of this operation, by giving predetermined surface ratio to a diaphragm 25 and a diaphragm 18, mass of a diaphragm 25 can be made small and weight of the whole shaker can be made small. Moreover, manufacture of a shaker becomes easy in order not to use the lever which is a mechanical transformer unlike shaker 10D of the gestalt 3 of operation. Moreover, since it is not necessary to prepare load mass outside, it can be said that it is advantageous to a miniaturization and the space factor at the time of attaching for the vibrated body 11 is good.
[0067] (Gestalt 5 of operation) It explains, referring to drawing 6 about the shaker in the gestalt 5 of the operation of this invention to a degree. Drawing 6 is the sectional view showing the structure of shaker 10F in the gestalt 5 of operation. In addition, in shaker 10F of the gestalt of this operation, it is the same as that of the gestalt 1 of operation to have York 12, a magnet 13, a senter pole 14, and 1st frame 15A as a fixed part, and to have the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.
[0068] Like [shaker 10F of the gestalt of this operation] the gestalt 4 of operation of drawing 5 , 15d of paths is established in the base of frame 15A, and 2nd frame 15B is attached in the upper part of frame 15A. And cylinder-like x [opening 15] are formed and, as for the Kaminaka center section of frame 15B, the 2nd diaphragm 25 is attached in this part free [vibration] through the damper.
[0069] Moreover, like the gestalt 3 of operation of drawing 4 , knife-edge-like supporting-point 15y is formed in a part of upper limit of frame 15B, and the lever 26 is attached free [rotation] focusing on this supporting-point 15y.

The end of a lever 26 is combined with a diaphragm 25 through a wire, and the load mass 27 is attached in the other end of a lever 26. Also in this case, a lever 26 acts as a mechanical transformer, a power point has it in the load mass 27 side, and point of application is in a diaphragm 25 side. On the other hand, the vacant room C is formed of the space surrounded by the diaphragm 18, frame 15B, and the diaphragm 25.

[0070] Thus, actuation of constituted shaker 10F is explained. if an electrical signal is added to the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. A lever 26 operates as a mechanical transformer. When die length from supporting-point 15y to the attachment section of a wire is set to r1 and die length from supporting-point 15y to the attachment section of the load mass 27 is set to r2, the transformer which makes r2/r1 a transformation ratio is constituted. And if mass of the load mass 27 is set to m, 2 (r2/r1) xm will act as a load of a diaphragm 25.

[0071] Furthermore, by making surface ratio of a diaphragm 18 to a diaphragm 25 larger than 1, it operates as an acoustical transformer also in this part. The mass of a diaphragm 25 and the appearance mass by 2 (r2/r1) xm are added, and the multiplication of the square of the above-mentioned sound transformation ratio is carried out. Comprehensive appearance mass, a call, and this value act this value on a diaphragm 18 through the air of a vacant room C. The air of the vacant room C which is compliance operates as an acoustical low pass filter. When the frequency of an electrical signal is lower than speech frequency, comprehensive appearance mass is combined with a diaphragm 18, and it vibrates to one. In this case, shaker 10F operate as a shaker literally, and vibrate the vibrated body 11.

[0072] The frequency of an electrical signal is higher than this, and, in the case of a speech frequency band, it is acoustically separated by the air of the vacant room C a diaphragm 18 and whose comprehensive appearance mass are low pass filters. At this time, a diaphragm 18 vibrates greatly and the sound pressure generated from this is emitted outside from 15d of paths like an arrow head e. In this case, shaker 10F operate as the sounding body. In order to be combined through the air of a vacant room C and for comprehensive appearance mass to join homogeneity on the whole top face of a diaphragm 18, it becomes unnecessary moreover, for a diaphragm 18 and a diaphragm 25 to take especially the reinforcement of a diaphragm 18 into consideration. Therefore, the ingredient of a diaphragm 18 and the degree of freedom of selection of structure improve. Moreover, mass of the whole shaker can be made small using the sound transformation ratio by the diaphragm 15 and the diaphragm 18.

[0073] Furthermore, in shaker 10F of the gestalt of this operation, two, the mechanical transformer which combines the load mass 27 using a lever 26, and the acoustical transformer which consists of surface ratio of a diaphragm 18 and a diaphragm 25, are used. For this reason, total mass of a diaphragm 25 can be made still lighter. Therefore, it can be made still lighter than the thing of the gestalt 4 of operation of the weight of the whole shaker.

[0074] (Gestalt 6 of operation) It explains, referring to drawing 7 about the shaker in the gestalt 6 of the operation of this invention to a degree. Drawing 7 is the sectional view showing the structure of shaker 10G in the gestalt 6 of operation. In addition, in shaker 10G of the gestalt of this operation, it is the same as that of the gestalt 1 of operation to have York 12, a magnet 13, a senter pole 14, and 1st frame 15A as a fixed part, and to have the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.

[0075] Furthermore, like [shaker 10G of the gestalt of this operation] the gestalt 5 of operation of drawing 6 , 15d of paths is established in the base of 1st frame 15A, and 2nd frame 15B is attached in the upper part of frame 15A. And cylinder-like x [opening 15] are formed and, as for the upper part of frame 15B, the 2nd diaphragm 25 is attached in this part free [vibration] through the damper.

[0076] Unlike the gestalt of old operation, 3rd frame 15C is attached in the lower part of 1st frame 15A. This frame 15C covers with the exterior the annular space formed in the periphery section of York 12, and the lower limit section of frame 15A, and serves to form the 2nd vacant room C2. And the acoustic resonance tubing 28 (it is only hereafter called tubing) is attached in the periphery section of frame 15C. An acoustic resonator consists of this vacant room C2 and tubing 28.

[0077] Thus, actuation of constituted shaker 10G is explained. if an electrical signal is added to the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. A diaphragm 18 and a diaphragm 25 operate as an acoustical transformer by giving predetermined surface ratio like the gestalt 4 of operation. The multiplication of this sound transformation ratio is carried out to the mass of a diaphragm 25, and it serves as a load of a vacant room C1. The air of a vacant room C1 operates as an acoustical low pass filter to a diaphragm 25. When the frequency of an electrical signal is lower than speech frequency, a diaphragm 25 is combined with a diaphragm 18 and it operates. In this case, shaker 10G operate as a shaker literally, and vibrate the vibrated body 11. When the frequency of an electrical signal is higher than speech frequency, it dissociates as acoustically as a diaphragm 25 and a diaphragm 18 vibrates greatly.

[0078] Furthermore, with the gestalt of this operation, the sound pressure generated by vibration of a diaphragm 18 is led to the acoustic resonator constituted with a vacant room C2 and tubing 28 through 15d of paths, as shown in an arrow head f. For this reason, when operating shaker 10G as the sounding body, according to the resonance phenomenon of an acoustic resonator, sound pressure level increases and the bigger sound reproduction of it becomes

possible.
[0079] (Gestalt 7 of operation) It explains, referring to drawing 8 - drawing 10 about the excitation equipment in the gestalt 7 of the operation of this invention to a degree. Drawing 8 is the connection diagram of the shaker 10 of the gestalt of this operation, and the electrical signal generator 30 and the acoustic signal generation circuit 31 which drive a shaker 10 in excitation mode. The excitation signal which is the shaker shown with the gestalten 1-6 of operation, and is generated with the electrical signal generator 30 shall be inputted into a shaker 10, and a shaker 10 shall operate.
[0080] The reaction force generated in the magnetic-circuit section of a shaker 10 serves as max with the mechanical lowest resonance frequency fo. And the vibrated body 11 can be excited most greatly in the neighborhood of this frequency band. Therefore, the electrical signal which had the predetermined bandwidth centering on lowest resonance frequency fo as the electrical signal generator 30 showed to drawing 9 is generated. And even when dispersion is in lowest resonance frequency fo by inputting this signal into a shaker 10 at the time of the mass production of a shaker 10, target exciting force can be acquired.
[0081] As an electrical signal with frequency bandwidth, as shown in drawing 10 , it is the range which contains the lowest frequency fo of a shaker using a sinusoidal signal, and if it considers as the signal with which the sweep of the frequency is carried out in time, the moment sweep frequency was in agreement with lowest resonance frequency fo, the reaction force generated in the magnetic-circuit section of a shaker 10 will serve as max. And the vibrated body 11 can be most greatly excited on this frequency. In addition, the effectiveness that either is the same is acquired the lower one from the one from the one where a frequency is lower where the direction of a sweep is higher, or the higher one. Moreover, after one round term of a frequency is completed, even if the wave of a sine wave is a wave which leads to a round term of the following frequency continuously, it may be a wave from which a period changes continuously with time amount. When it uses for a cellular phone, since the way [it carries out to a multiple-times continuation target and carries out the sweep of multiple times again after the pause for 1 - 2 seconds] senses a sweep for the body as change of a big tactile sense, it is more desirable.
[0082] Drawing 11 is the circuit diagram showing other examples of the electrical signal generator 40. In this Fig., 41 is a square wave signal generating circuit, and the output is inputted into the switching circuit which consists of a transistor 42. As for 43 and 44, the resistance for bias of the transistor 42 for switching and 45 are dc-batteries. A transistor 42 will be in ON condition on an electrical potential difference Vin (V), and this electrical signal generator 40 is output voltage Vout in an outgoing end, if a square wave signal is inputted into a transistor 42 from a square wave generator 41. It generates. Next, if an input wave is set to 0 (V), a transistor 42 will be in an OFF condition and an output wave will also be set to 0 (V). Therefore, if a period makes a square wave signal in time the square wave signal by which a sweep is carried out, a period will serve as a signal by which the sweep was carried out and an output wave will also add this signal to a shaker 10, the moment the sweep period was in agreement with lowest resonance frequency fo, the reaction force generated in the magnetic-circuit section of a shaker 10 will serve as max. And the vibrated body 11 can be most greatly excited on this frequency. Although it is the same as that of the case of the sinusoidal signal of drawing 10 , since this operation is using the dc-battery of the terminal for mobile communications, such as a cellular phone, as the power source, it has the description that the driving signal of a shaker can be easily made from ON-OFF of battery voltage, and is more practical.
[0083] In addition, although the input signal to a transistor 42 was made into the square wave with the gestalt of this operation, it is good also as a sine wave. Also in this case, a transistor 42 can carry out ON-OFF actuation, and can generate the output signal of a square wave.
[0084] Although a shaker 10 pronounces in vibration and a speech frequency band in a low frequency region, if it is made to vibrate by the square wave signal of low frequency, a loud sound will occur with vibration for the frequency component of the higher harmonic which a square wave has. Since the pronunciation by this harmonic content becomes the bent thing, as for harmonic content, cutting electrically is desirable. The electrical signal generator with which drawing 12 shows the circuit for it, and 40 carries out a square wave, and 51 are [a low pass filter (LPF) and 52] signal change-over switches. The electrical signal generator 40 will generate a square wave signal, if the control signal which is not illustrated is inputted. Although not displayed here, the signal change-over switch 52 is connected to a low pass filter 51 side, when interlocking and switching to an input signal and vibrating it. The harmonic content which a square wave signal contains is not cut, the electrical signal which does not contain harmonic content is inputted into a shaker 10, and a low pass filter 51 prevents that a distortion sound is reproduced at the time of actuation of vibration. Moreover, at the time of playback of a sound, the signal change-over switch 52 switches, the output of the acoustic signal generation circuit 31 is connected to the direct shaker 10, and it becomes reproducible [without the reproducible effect of a low pass filter 51]. In addition, comparatively low 150-200Hz or less of people's acoustic-sense sensibility of the treble cut off frequency of a low pass filter 51 is desirable.
[0085] Moreover, although the signal added as an object for oscillating playback of a shaker with the gestalt of this operation was a sine wave or a square wave, as long as the resonance frequency of vibration is included, the random-noise signal which has frequency bandwidth, for example, or a music signal is sufficient as it.

[0086] (Gestalt 8 of operation) It explains, referring to drawing 13 about the personal digital assistant equipment in the gestalt 8 of the operation of this invention to a degree. Drawing 13 is the sectional view showing the structure of personal digital assistant equipment. When personal digital assistant equipment considers as a cellular phone, it is constituted including a housing 61, the transceiver circuit which is not illustrated, a voice-input/output circuit, a key input circuit, etc. Here, the arrival of a cellular phone shall be told to a user by vibration of the housing 61 instead of a sound. For this reason, the shaker 10 of the gestalten 1-7 of operation is attached in some housings 61. The shaker 10 of the gestalt of this operation performs excitation and a voice output, as mentioned above. Opening 61a is prepared in a housing 61, and the voice of a shaker 10 is emitted from this opening 61a.
[0087] If the electrical signal of a frequency lower than speech frequency is added to a shaker 10, vibration of a shaker 10 will be transmitted to a housing 61 through a frame 15. When the user puts in and possesses this personal digital assistant equipment in the pocket of clothes etc., vibration of a housing 61 can be sensed corporally. On the other hand, if the electrical signal of speech frequency is added, a shaker 10 will operate as the sounding body and ringer tone voice will be outputted to the exterior of a box 61 outside through opening 61a like an arrow head g.
[0088] Although components with separate shaker and sounding body constituted from the conventional cellular phone, both actuation with excitation and pronunciation can be performed by using the shaker of this invention. For this reason, while realizing a miniaturization and lightweight-izing of personal digital assistant equipment, low-pricing by reduction of components mark is attained.
[0089] In addition, although the cellular phone was made into the example as personal digital assistant equipment in drawing 13 , even if it uses a pager etc. for other personal digital assistant equipments, it cannot be overemphasized that an equivalent function is obtained. Moreover, although the gestalt of this operation has not described the electrical signal inputted into the shaker attached in personal digital assistant equipment, it cannot be overemphasized that it is desirable to drive with drawing 8 and the electrical signal generators 30 and 40 stated by 9, 10, 11, and 12. Furthermore, the device to attach may not be limited to personal digital assistant equipment, either, and may be used for the various devices which need playback of vibration and a sound, for example, audio equipment, and a game device.
[0090]
[Effect of the Invention] the electromagnetism which is generated in an excitation coil as mentioned above by establishing the structure of combining load mass or the 2nd diaphragm with the 1st diaphragm through compliance according to invention of claims 1-23 -- reaction force can be told to the magnetic-circuit section. When a sound signal is inputted, vibration of the 1st diaphragm is emitted outside as a sound. When the signal lower than speech frequency for excitation is impressed, if the 1st diaphragm vibrates, load mass or the 2nd diaphragm will vibrate to one through compliance. In this case, it can operate as a shaker and the vibrated body can be vibrated.
[0091] Moreover, although two units of a shaker and a loudspeaker were prepared conventionally, according to invention of claims 24 and 25, a shaker and the sounding body can be summarized to one by building such a shaker and excitation equipment into personal digital assistant equipment. For this reason, the miniaturization of personal digital assistant equipment and lightweight-ization are attained, and low-pricing by reduction of components mark can be realized. Since it generates by the elastic vibration of an inertial load, energy loss of vibration in this case decreases. For this reason, the effectiveness that the operating time of the cell of personal digital assistant equipment becomes long arises.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the personal digital assistant equipment furnished with the shaker, the excitation equipment and the shaker, or excitation equipment which has a pronunciation function.

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PRIOR ART

[Description of the Prior Art] An example of the conventional electrodynamic type shaker is explained. Drawing 14 is the sectional view showing the structure of the conventional electrodynamic type shaker, and is constituted including a housing 101, a magnetic circuit 102, the excitation coil 103, an absorber 104, and the voice coil bobbin 105. A housing 101 is the housing of the shaker itself, and a housing which became personal digital assistant equipment in common. Monotonous section 101a is formed in some housings 101. The time volume of the lower limit section is carried out with the excitation coil 103, and the voice coil bobbin 105 is in the condition that the upper limit section fixed to oscillating section 101a of a housing.
[0003] In the electrodynamic type shaker of such a configuration, if the electrical signal of an alternating current is impressed to the excitation coil 103, electromagnetic force will occur between the excitation coil 103 and a magnetic circuit 102, and the voice coil bobbin 105 will vibrate to shaft orientations. The magnetic circuit 102 including the center pole and York is held free [vibration] with the housing 101 down side through the damper 104. For this reason, both a magnetic circuit 104 and the housing 101 vibrate mutually according to the reaction of electromagnetic force. Vibration of a housing 101 is transmitted [shaker / of a through lever / electrodynamic type] to the user who attached to the body in monotonous section 101a.

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EFFECT OF THE INVENTION

[Effect of the Invention] the electromagnetism which is generated in an excitation coil as mentioned above by establishing the structure of combining load mass or the 2nd diaphragm with the 1st diaphragm through compliance according to invention of claims 1-23 -- reaction force can be told to the magnetic-circuit section. When a sound signal is inputted, vibration of the 1st diaphragm is emitted outside as a sound. When the signal lower than speech frequency for excitation is impressed, if the 1st diaphragm vibrates, load mass or the 2nd diaphragm will vibrate to one through compliance. In this case, it can operate as a shaker and the vibrated body can be vibrated.
[0091] Moreover, although two units of a shaker and a loudspeaker were prepared conventionally, according to invention of claims 24 and 25, a shaker and the sounding body can be summarized to one by building such a shaker and excitation equipment into personal digital assistant equipment. For this reason, the miniaturization of personal digital assistant equipment and lightweight-ization are attained, and low-pricing by reduction of components mark can be realized. Since it generates by the elastic vibration of an inertial load, energy loss of vibration in this case decreases. For this reason, the effectiveness that the operating time of the cell of personal digital assistant equipment becomes long arises.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in such a conventional electrodynamic type shaker, since resonance sharpness is proportional to the mass of vibration system, in order to acquire the big force near resonance frequency, mass of a magnetic circuit 102 must be enlarged. When carried out like this, there was a fault that the weight of the whole shaker will become very big.
[0005] Moreover, when mass of a magnetic circuit 102 was enlarged, there was a problem that the own vibration of a magnetic circuit becomes small, and were hard coming to generate a sound from a magnetic circuit 102, and effectiveness worsened as the sounding body.
[0006] By being made in view of such a conventional trouble, and minding compliance between the diaphragm of a **** conversion mold, and the load mass made to add to a diaphragm, on a low frequency, this invention is operated as a shaker and aims at realizing the shaker operated as the sounding body with a high frequency. Furthermore, by preparing a transformer, the weight on the appearance of load mass is reduced and it aims at suppressing the increment in weight of the whole shaker.

[Translation done.]

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MEANS

[Means for Solving the Problem] In order to solve such a technical problem, invention of this application according to claim 1 The diaphragm which vibrates with low frequency and a speech frequency band at least, and the excitation coil attached in said diaphragm through the bobbin, said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force, and the inertial load which has predetermined mass When the compliance prepared between said diaphragms and said inertial loads is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said inertial load and said diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is characterized by said diaphragm vibrating by said compliance and making it pronounce.
[0008] Moreover, in invention of this application according to claim 2, said compliance is characterized by being the spring connected to said diaphragm and said inertial load in a shaker according to claim 1.
[0009] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, an inertial load and a diaphragm vibrate to one. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. Moreover, when a sound signal is impressed to an excitation coil, only a diaphragm vibrates by compliance and voice is emitted outside. Therefore, both the functions of a shaker and the sounding body are attained by one equipment.
[0010] Moreover, the 1st diaphragm to which invention of this application according to claim 3 vibrates with low frequency and a speech frequency band at least, the excitation coil attached in said 1st diaphragm through the bobbin, and said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force The 2nd diaphragm which is held free [vibration] to the frame which supports said 1st diaphragm, and has a resonant frequency lower than said 1st diaphragm, When the compliance prepared between said 1st diaphragm and said 2nd diaphragm is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce.
[0011] Moreover, in invention of this application according to claim 4, said compliance is characterized by being the air chamber sealed with said the 1st diaphragm, said 2nd diaphragm, and said frame in a shaker according to claim 3.
[0012] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, the 1st diaphragm and 2nd diaphragm vibrate to one. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. When a sound signal is impressed to an excitation coil, only said 1st diaphragm vibrates by said compliance, and voice is emitted outside. Therefore, both the functions of a shaker and the sounding body are attained by one equipment. Local stress does not join the diaphragm of **** 1.
[0013] Moreover, the diaphragm to which invention of this application according to claim 5 vibrates with low frequency and a speech frequency band at least, the excitation coil attached in said diaphragm through the bobbin, and said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force The inertial load which has predetermined mass, and the mechanical transformer which changes the mass of said inertial load through vibration system, When the compliance prepared between said diaphragms the primary said mechanical transformer side is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said inertial load and said diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce.
[0014] Moreover, in invention of this application according to claim 6, said compliance is characterized by being said spring connected with the diaphragm at the primary said mechanical transformer side in a shaker according to claim 5.
[0015] Moreover, in invention of this application according to claim 7, in a shaker according to claim 5, said compliance is attached in an end, said inertial load is attached in the other end, and said mechanical transformer is characterized by being the lever which has the supporting point in the frame which supports said 1st diaphragm.

[0016] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, an inertial load and a diaphragm vibrate to one through a mechanical transformer. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. When a sound signal is impressed to an excitation coil, only the 1st diaphragm vibrates by compliance and voice is emitted outside. Therefore, both the functions of a shaker and the sounding body are attained by one equipment. Moreover, the mass of an inertial load is smaller than the thing of claim 1 and two publications, and ends.

[0017] Moreover, the 1st diaphragm to which invention of this application according to claim 8 vibrates with low frequency and a speech frequency band at least, the excitation coil attached in said 1st diaphragm through the bobbin, and said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force The 2nd diaphragm with an effective area it is held free [vibration] to the frame which supports said 1st diaphragm, and smaller than said 1st diaphragm, When the compliance prepared between said 1st diaphragm and said 2nd diaphragm is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce.
[0018] Moreover, in invention of this application according to claim 9, said compliance is characterized by being the air chamber sealed with said the 1st diaphragm, said 2nd diaphragm, and said frame in a shaker according to claim 8.
[0019] Moreover, in invention of this application according to claim 10, said 2nd diaphragm is characterized by constituting the acoustical transformer which increases the oscillating load of said 1st diaphragm through said air chamber in a shaker according to claim 8.
[0020] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, the 1st diaphragm and 2nd diaphragm vibrate to one through compliance. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. When a sound signal is impressed to an excitation coil, only the 1st diaphragm vibrates by compliance and voice is emitted outside. Therefore, both the functions of a shaker and the sounding body are attained by one equipment. The diaphragm of **** 2 is good in small area, and local stress does not join the 1st diaphragm.
[0021] Moreover, the 1st diaphragm to which invention of this application according to claim 11 vibrates with low frequency and a speech frequency band at least, the excitation coil attached in said 1st diaphragm through the bobbin, and said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force The 2nd diaphragm with an effective area it is held free [vibration] to the frame which supports said 1st diaphragm, and smaller than said 1st diaphragm, With the compliance prepared between said 1st diaphragm and said 2nd diaphragm When the mass of the inertial load which has predetermined mass, and said inertial load is changed through vibration system, the mechanical transformer which gives a conversion load to said 2nd diaphragm is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce.
[0022] Moreover, in invention of this application according to claim 12, said compliance is characterized by being the air chamber sealed with said the 1st diaphragm, said 2nd diaphragm, and said frame in a shaker according to claim 11.
[0023] Moreover, in invention of this application according to claim 13, in a shaker according to claim 11, said compliance is attached in an end, said inertial load is attached in the other end, and said mechanical transformer is characterized by being the lever which has the supporting point in the frame which supports said 1st diaphragm.
[0024] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, the 1st diaphragm, 2nd diaphragm, and inertial load vibrate to one. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. When a sound signal is impressed to an excitation coil, only the 1st diaphragm vibrates by compliance and voice is emitted outside. Therefore, both the functions of a shaker and the sounding body are attained by one equipment. The diaphragm of **** 2 is good in small area, and local stress does not join the 1st diaphragm. The mass of an inertial load is still smaller than a thing according to claim 5 to 7, and ends.
[0025] Moreover, the 1st diaphragm to which invention of this application according to claim 14 vibrates with low frequency and a speech frequency band at least, the excitation coil attached in said 1st diaphragm through the bobbin, and said excitation coil -- electromagnetism -- with the magnetic circuit which gives driving force The 2nd diaphragm with an effective area it is held free [vibration] to the frame which supports said 1st diaphragm, and smaller than said 1st diaphragm, The 1st air chamber which was prepared between said 1st diaphragm and said 2nd diaphragm, and was sealed, When input the aerial vibration generated in said 1st air chamber, it is made to pile up, the 2nd air chamber which makes aerial vibration output outside through tubing is provided and the AC signal of a frequency lower than speech frequency is impressed to said excitation coil, When said the 1st diaphragm and said 2nd diaphragm vibrate to one and the signal of a speech frequency band is impressed to said excitation coil, it is

characterized by said 1st diaphragm vibrating by said compliance, and making it pronounce.
[0026] According to such a configuration, when an AC signal lower than speech frequency is impressed to an excitation coil, the 1st diaphragm and 2nd diaphragm vibrate to one through compliance. Reaction force arises on the frame which holds a magnetic circuit and this at this time, and this reaction force gets across to the vibrated body. When a sound signal is impressed to an excitation coil, only the 1st diaphragm vibrates by compliance. Since this sound pressure is outputted through tubing combined with the 2nd air chamber Sound pressure level increases more according to an acoustic resonance phenomenon., Moreover, both the functions of a shaker and the sounding body are attained by one equipment. The 2nd diaphragm is still better in small area, and local stress does not join the 1st diaphragm.
[0027] Moreover, invention of this application according to claim 15 is characterized by providing the electrical signal generator which inputs into said shaker an electrical signal with the predetermined frequency bandwidth which contains the resonance frequency of vibration at least as a shaker according to claim 1 to 14.
[0028] Moreover, invention of this application according to claim 16 is characterized by providing a shaker according to claim 1 to 14 and the electrical signal generator which inputs into said shaker the electrical signal which carries out the sweep of the frequency in time including the resonance frequency of vibration at least.
[0029] Moreover, in invention of this application according to claim 17, said electrical signal generator is characterized by generating the sinusoidal signal from which a frequency changes with sweeps in excitation equipment according to claim 16.
[0030] Moreover, in invention of this application according to claim 18, said electrical signal generator is characterized by generating the square wave signal from which a frequency changes with sweeps in excitation equipment according to claim 16.
[0031] Moreover, invention of this application according to claim 19 is characterized by preparing the low pass filter which makes a frequency lower than the speech frequency reproduced to the output side of said electrical signal generator cut-off frequency in excitation equipment according to claim 18.
[0032] Moreover, in invention of this application according to claim 20, said excitation coil is characterized by driving with the excitation signal of the predetermined bandwidth containing the resonance frequency of said inertial load in the shaker of claims 1, 2, 5, 6, and 7.
[0033] Moreover, in invention of this application according to claim 21, said excitation coil is characterized by driving with the excitation signal of the predetermined bandwidth containing the resonance frequency of said 2nd diaphragm in the shaker of claims 3, 4, 8-14.
[0034] Moreover, in invention of this application according to claim 22, said excitation coil is characterized by driving with the excitation signal by which a sweep is carried out in the predetermined range containing the resonance frequency of said inertial load in the shaker of claims 1, 2, 5, 6, and 7.
[0035] Moreover, in invention of this application according to claim 23, said excitation coil is characterized by driving with the excitation signal by which a sweep is carried out in the predetermined range containing the resonance frequency of said 2nd diaphragm in the shaker of claims 3, 4, 8-14.
[0036] Moreover, with the personal digital assistant equipment of this application according to claim 24, it is characterized by providing the shaker of 20-23 claims 1-14 and given in any 1 term.
[0037] Moreover, with the personal digital assistant equipment of this application according to claim 25, it is characterized by providing the excitation equipment of claim 15-19 given in any 1 term.
[0038] According to such a configuration, the resonance frequency in the excitation mode of a resonator varies, and even if it is, the 1st diaphragm, 2nd diaphragm, or inertial load resonates certainly.
[0039]
[Embodiment of the Invention]
(Gestalt 1 of operation) It explains, referring to drawing 1 about the shaker in the gestalt 1 (the 1) of operation of this invention. Drawing 1 is the sectional view showing the structure of shaker 10A of the gestalt of this operation. This shaker 10A has structure which fixed on the vibrated body 11 which are some housings, has York 12, a magnet 13, a senter pole 14, and a frame 15 as a fixed part, and has the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.
[0040] York 12 was processed in the shape of a cup with the magnetic metal, and along with the medial axis, a disc-like magnet 13 and the disc-like center pole 14 carried out the laminating of it, and have fixed it. Here, a magnet 13 and the center pole 14 have become in midair. The opening which the periphery section of the center pole 14 and the inner circumference section of York 12 form forms a magnetic gap, and the excitation coil 17 by which the time volume was carried out to the periphery section of the voice coil bobbin 16 is held in this magnetic gap.
[0041] The periphery section is formed, the inner circumference section is really formed in the shape of a dome in the shape of a cone, and the diaphragm 18 is held free [vibration] through the edge 19 to the frame 15. If the center section of a diaphragm 18 is set to dome section 18a, the end of a spring 20 has fixed at the core of dome section 18a. And the load mass 21 is attached in the other end of a spring 20 as an inertial load. Furthermore, the voice coil bobbin

16 pastes dome section 18a, and the voice coil bobbin 16 and a diaphragm 18 carry out a piston action to one. If load mass 21 is made into the mass of vibration system, a spring 20 will achieve the function of compliance. The spring 20 in this case is used as the vine volume spring.

[0042] The load mass 21 is plate-like and the path of air is secured spacing the periphery edge of a frame 15, and predetermined. This path is an air duct by which the sound was made to be emitted to the exterior of shaker 10A, when sound pressure occurs by vibration of a diaphragm 18.

[0043] Thus, actuation of shaker 10A of the gestalt 1 of the constituted operation is explained. if an electrical signal is impressed by the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. this time -- electromagnetism -- the reaction force of driving force arises and reaction force is transmitted to the magnetic-circuit section and the frame 15 which are a fixed part in proportion to the acceleration of the diaphragm 18 which is moving part. If the magnetic-circuit section which consists of York 12, a magnet 13, and a senter pole 14 vibrates according to this reaction force, that vibration will get across also to the vibrated body 11.

[0044] The spring 20 which serves as compliance acts as a low pass filter to the load mass 21. When the frequency of the electrical signal impressed to the excitation coil 17 is lower than a speech frequency band, a diaphragm 18 and the load mass 21 are united, and operate. For this reason, near the lowest resonance frequency of shaker 10A, resonance sharpness becomes large and the acceleration of a diaphragm 18 also becomes large. Therefore, since this reaction force becomes large, shaker 10A can vibrate the vibrated body 11.

[0045] When the frequency of the electrical signal impressed as compared with resonance frequency is high (speech frequency band used by telephone etc.), a diaphragm 18 and the load mass 21 are mechanically separated by the spring 20 which is a low pass filter. In this case, since vibrational energy is not transmitted to the load mass 21, a diaphragm 18 vibrates greatly. Sound pressure arises by vibration of this diaphragm 18, and that sound pressure is emitted to outer space from a path like an arrow head a. This condition is actuation as the so-called loudspeaker, and shaker 10A will operate as the sounding body with the usual speech frequency band.

[0046] Next, it explains, referring to drawing 2 about the shaker in the gestalt 1 (the 2) of operation of this invention. Drawing 2 is the sectional view showing the structure of shaker 10B of the gestalt of this operation. In addition, at shaker 10A shown in drawing 1 , although the magnetic-circuit section is attached in the vibrated body 11, shaker 10B is attached in the sense to which the load mass 21 approaches the vibrated body 11 as shown in drawing 2 R> 2 with the gestalt of this operation. Since each part which constitutes shaker 10B is the same as that of shaker 10A of drawing 1 , explanation of the same part is omitted.

[0047] In this shaker 10B, 2nd path 15a is prepared in the side face of a frame 15. This path 15a is a hole which makes the sound pressure generated by vibration of a diaphragm 18 output outside.

[0048] Actuation of the vibration to the signal of the low frequency in shaker 10B of such a configuration and generating of the sound in a speech frequency band is the same as that of shaker 10A of the structure shown in drawing 1 . That is, if the electrical signal of the frequency of speech frequency is impressed, it will operate as the sounding body and the sound will be emitted outside through path 15a. Moreover, if the electrical signal of a frequency lower than speech frequency is impressed, it will operate as a shaker. Moreover, if both electrical signals are impressed, it will operate to coincidence as a shaker and the sounding body. Thus, a usage can be chosen by the application.

[0049] (Gestalt 2 of operation) It explains, referring to drawing 3 about the shaker in the gestalt 2 of the operation of this invention to a degree. Drawing 3 is the sectional view showing the structure of shaker 10C in the gestalt 2 of operation. In addition, in shaker 10C of the gestalt of this operation, it is the same as that of the gestalt 1 of operation to have York 12, a magnet 13, a senter pole 14, and a frame 15 as a fixed part, and to have the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.

[0050] If a diaphragm 18 is used as the 1st diaphragm, the 2nd diaphragm 22 is formed in the gestalt of this operation. A diaphragm 22 is a diaphragm which vibrates indirectly through the air of a vacant room C, when it is held by 2nd edge 22a free [vibration] to a frame 15 and a diaphragm 18 vibrates by low frequency. The vacant room C said the space surrounded by the side face of diaphragms 18 and 22 and a frame 15, and has achieved the function of compliance to the diaphragm 22.

[0051] Path 15b is prepared in the pars basilaris ossis occipitalis of a frame 15. This path 15b is a hole which makes the sound pressure in the bottom space generated by vibration of a diaphragm 18 output outside. This shaker 10C is attached in the vibrated body 11 through the pars basilaris ossis occipitalis of York 12.

[0052] Actuation of shaker 10C of such a configuration is explained. if an electrical signal is added to the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. The air of the vacant room C which is compliance operates as an acoustical low pass filter to a diaphragm 22. When the frequency of an electrical signal is lower than speech frequency, a diaphragm 18 and the diaphragm 22 combined through the vacant room C are united, and vibrates.

[0053] The frequency of an electrical signal is higher than this, and, in the case of a speech frequency band, it is

acoustically separated by the air of the vacant room C a diaphragm 18 and whose diaphragm 22 are low pass filters. Since the energy of a diaphragm 18 is not transmitted to a diaphragm 22 at this time, a diaphragm 18 vibrates greatly. The sound pressure generated with a diaphragm 18 at this time is emitted outside from path 15b like an arrow head b, and a sound gets across to people. Thus, with a speech frequency band, shaker 10C operates as the sounding body.

[0054] Furthermore, with the gestalt of this operation, since a diaphragm 18 and a diaphragm 22 are combined through the air of a vacant room C, when the frequency of an electrical signal is low, the mass of a diaphragm 22 joins homogeneity in the whole field of a diaphragm 18. For this reason, compared with the gestalt 1 of operation, the reinforcement of a diaphragm 18 may not be so strong. Therefore, the ingredient of a diaphragm 18 and the degree of freedom of selection of structure improve.

[0055] (Gestalt 3 of operation) It explains, referring to drawing 4 about the shaker in the gestalt 3 of the operation of this invention to a degree. Drawing 4 is the sectional view showing the structure of shaker 10D in the gestalt 3 of operation. In addition, in shaker 10D of the gestalt of this operation, it is the same as that of the gestalt 1 of operation to have York 12, a magnet 13, a senter pole 14, and a frame 15 as a fixed part, and to have the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.

[0056] The end of a spring 20 is attached in dome section 18a of the diaphragm 18 in the gestalt of this operation. And the load mass 24 is attached in the other end of this spring 20 free [vibration] through the lever 23. Supporting-point 15c is formed in a part of edge of a frame 15 in the shape of knife edge. A lever 23 is a mechanical transformer which makes r2/r1 a transformation ratio, when it is held by supporting-point 15c, die length from supporting-point 15c to the attachment section of a spring 20 is set to r1 and die length from supporting-point 15c to the attachment section of the load mass 24 is set to r2. The power point in this case is in the load mass 24 side, and point of application is in a spring 20 side.

[0057] Actuation of shaker 10D of such a configuration is explained. if an electrical signal is added to the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. If a lever 23 operates as a mechanical transformer and sets mass of the load mass 24 to m, 2 (r2/r1) xm will act as a load of a spring 20.

[0058] The spring 20 which serves as compliance operates as a low pass filter to a lever 23 and the load mass 24. When the frequency of an electrical signal is lower than speech frequency, it is combined with a diaphragm 18 through a lever 23, and the load mass 24 vibrates to one. In this way, shaker 10D vibrates the vibrated body 11.

[0059] The frequency of an electrical signal is higher than this, and, in the case of a speech frequency band, a diaphragm 18 is mechanically separated to the load mass 24 by the spring 20 which is a low pass filter. In this case, since the energy of a diaphragm 18 is not transmitted to the load mass 24 through a lever 23 at this time, a diaphragm 18 vibrates greatly. The sound pressure generated with a diaphragm 18 is emitted outside like an arrow head c. In this way, shaker 10D operates as the sounding body.

[0060] Furthermore, with the gestalt of this operation, since the load mass 24 is combined with a spring 20 through a lever 23, mass m of the load mass 24 can be made small in inverse proportion to the square of a transformation ratio. For this reason, weight of shaker 10D can be made small.

[0061] (Gestalt 4 of operation) It explains, referring to drawing 5 about the shaker in the gestalt 4 of the operation of this invention to a degree. Drawing 5 is the sectional view showing the structure of shaker 10E in the gestalt 4 of operation. In addition, in shaker 10E of the gestalt of this operation, it is the same as that of the gestalt 1 of operation to have York 12, a magnet 13, a senter pole 14, and 1st frame 15A as a fixed part, and to have the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.

[0062] In order to make shaker 10E of the gestalt of this operation open the air chamber of the tooth back of a diaphragm 18 for free passage with the exterior like the gestalt 2 of operation of drawing 3 , 15d of paths is established in the base of frame 15A. On the other hand, unlike the gestalt 2 of operation, 2nd frame 15B is attached in the upper part of frame 15A. Cylinder-like x [opening 15] are formed and, as for the Kaminaka center section of frame 15B, the 2nd diaphragm 25 is attached in this part free [vibration] through edge 25a. In this way, the vacant room C is formed of the space surrounded by the diaphragm 18, frame 15B, and the diaphragm 25.

[0063] Thus, actuation of constituted shaker 10E is explained. Effective area of a diaphragm 18 is set to S1, area of a diaphragm 25 is set to S2, and mass is set to m. if an electrical signal is added to the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. An acoustical transformer can be constituted by making surface ratio (S1/S2) larger than 1. It is called the equivalence load which looked at the value and the multiplication value of the mass m of a diaphragm 25 which carried out the square of a sound transformation ratio, and a call and this ratio for this surface ratio from the diaphragm 18.

[0064] The air of a vacant room C which serves as compliance acts as an acoustical low pass filter to a diaphragm 25. When the frequency of an electrical signal is lower than speech frequency, it combines with a diaphragm 18 through the air of a vacant room C, and a diaphragm 25 vibrates to one. In this case, shaker 10E can operate as a shaker literally, and can vibrate the vibrated body 11.

[0065] The frequency of an electrical signal is higher than this, and, in the case of a speech frequency band, it is acoustically separated by the air of the vacant room C a diaphragm 18 and whose diaphragm 25 are low pass filters. In this case, a diaphragm 18 vibrates greatly and the sound pressure generated from this is emitted outside from 15d of paths like an arrow head d. At this time, shaker 10E operates as the sounding body. Moreover, a diaphragm 18 and a diaphragm 25 are [as opposed to / since it is combined through the air of a vacant room C / a diaphragm 18] 2 xm equivalent (S1/S2). Mass is added. It becomes unnecessary for this reason, to strengthen reinforcement of a diaphragm 18 so much compared with shaker 10A of the gestalt 1 of operation. Therefore, the ingredient of a diaphragm 18 and the degree of freedom of selection of structure improve.
[0066] Furthermore, with the gestalt of this operation, by giving predetermined surface ratio to a diaphragm 25 and a diaphragm 18, mass of a diaphragm 25 can be made small and weight of the whole shaker can be made small. Moreover, manufacture of a shaker becomes easy in order not to use the lever which is a mechanical transformer unlike shaker 10D of the gestalt 3 of operation. Moreover, since it is not necessary to prepare load mass outside, it can be said that it is advantageous to a miniaturization and the space factor at the time of attaching for the vibrated body 11 is good.
[0067] (Gestalt 5 of operation) It explains, referring to drawing 6 about the shaker in the gestalt 5 of the operation of this invention to a degree. Drawing 6 is the sectional view showing the structure of shaker 10F in the gestalt 5 of operation. In addition, in shaker 10F of the gestalt of this operation, it is the same as that of the gestalt 1 of operation to have York 12, a magnet 13, a senter pole 14, and 1st frame 15A as a fixed part, and to have the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.
[0068] Like [shaker 10F of the gestalt of this operation] the gestalt 4 of operation of drawing 5 , 15d of paths is established in the base of frame 15A, and 2nd frame 15B is attached in the upper part of frame 15A. And cylinder-like x [opening 15] are formed and, as for the Kaminaka center section of frame 15B, the 2nd diaphragm 25 is attached in this part free [vibration] through the damper.
[0069] Moreover, like the gestalt 3 of operation of drawing 4 , knife-edge-like supporting-point 15y is formed in a part of upper limit of frame 15B, and the lever 26 is attached free [rotation] focusing on this supporting-point 15y. The end of a lever 26 is combined with a diaphragm 25 through a wire, and the load mass 27 is attached in the other end of a lever 26. Also in this case, a lever 26 acts as a mechanical transformer, a power point has it in the load mass 27 side, and point of application is in a diaphragm 25 side. On the other hand, the vacant room C is formed of the space surrounded by the diaphragm 18, frame 15B, and the diaphragm 25.
[0070] Thus, actuation of constituted shaker 10F is explained. if an electrical signal is added to the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. A lever 26 operates as a mechanical transformer. When die length from supporting-point 15y to the attachment section of a wire is set to r1 and die length from supporting-point 15y to the attachment section of the load mass 27 is set to r2, the transformer which makes r2/r1 a transformation ratio is constituted. And if mass of the load mass 27 is set to m, 2 (r2/r1) xm will act as a load of a diaphragm 25.
[0071] Furthermore, by making surface ratio of a diaphragm 18 to a diaphragm 25 larger than 1, it operates as an acoustical transformer also in this part. The mass of a diaphragm 25 and the appearance mass by 2 (r2/r1) xm are added, and the multiplication of the square of the above-mentioned sound transformation ratio is carried out. Comprehensive appearance mass, a call, and this value act this value on a diaphragm 18 through the air of a vacant room C. The air of the vacant room C which is compliance operates as an acoustical low pass filter. When the frequency of an electrical signal is lower than speech frequency, comprehensive appearance mass is combined with a diaphragm 18, and it vibrates to one. In this case, shaker 10F operate as a shaker literally, and vibrate the vibrated body 11.
[0072] The frequency of an electrical signal is higher than this, and, in the case of a speech frequency band, it is acoustically separated by the air of the vacant room C a diaphragm 18 and whose comprehensive appearance mass are low pass filters. At this time, a diaphragm 18 vibrates greatly and the sound pressure generated from this is emitted outside from 15d of paths like an arrow head e. In this case, shaker 10F operate as the sounding body. In order to be combined through the air of a vacant room C and for comprehensive appearance mass to join homogeneity on the whole top face of a diaphragm 18, it becomes unnecessary moreover, for a diaphragm 18 and a diaphragm 25 to take especially the reinforcement of a diaphragm 18 into consideration. Therefore, the ingredient of a diaphragm 18 and the degree of freedom of selection of structure improve. Moreover, mass of the whole shaker can be made small using the sound transformation ratio by the diaphragm 15 and the diaphragm 18.
[0073] Furthermore, in shaker 10F of the gestalt of this operation, two, the mechanical transformer which combines the load mass 27 using a lever 26, and the acoustical transformer which consists of surface ratio of a diaphragm 18 and a diaphragm 25, are used. For this reason, total mass of a diaphragm 25 can be made still lighter. Therefore, it can be made still lighter than the thing of the gestalt 4 of operation of the weight of the whole shaker.
[0074] (Gestalt 6 of operation) It explains, referring to drawing 7 about the shaker in the gestalt 6 of the operation of this invention to a degree. Drawing 7 is the sectional view showing the structure of shaker 10G in the gestalt 6 of

operation. In addition, in shaker 10G of the gestalt of this operation, it is the same as that of the gestalt 1 of operation to have York 12, a magnet 13, a senter pole 14, and 1st frame 15A as a fixed part, and to have the voice coil bobbin 16, the excitation coil 17, and the diaphragm 18 as moving part.

[0075] Furthermore, like [shaker 10G of the gestalt of this operation] the gestalt 5 of operation of drawing 6 , 15d of paths is established in the base of 1st frame 15A, and 2nd frame 15B is attached in the upper part of frame 15A. And cylinder-like x [opening 15] are formed and, as for the upper part of frame 15B, the 2nd diaphragm 25 is attached in this part free [vibration] through the damper.

[0076] Unlike the gestalt of old operation, 3rd frame 15C is attached in the lower part of 1st frame 15A. This frame 15C covers with the exterior the annular space formed in the periphery section of York 12, and the lower limit section of frame 15A, and serves to form the 2nd vacant room C2. And the acoustic resonance tubing 28 (it is only hereafter called tubing) is attached in the periphery section of frame 15C. An acoustic resonator consists of this vacant room C2 and tubing 28.

[0077] Thus, actuation of constituted shaker 10G is explained. if an electrical signal is added to the excitation coil 17 -- electromagnetism -- driving force occurs and the diaphragm 18 combined with the voice coil bobbin 16 carries out a piston action up and down. A diaphragm 18 and a diaphragm 25 operate as an acoustical transformer by giving predetermined surface ratio like the gestalt 4 of operation. The multiplication of this sound transformation ratio is carried out to the mass of a diaphragm 25, and it serves as a load of a vacant room C1. The air of a vacant room C1 operates as an acoustical low pass filter to a diaphragm 25. When the frequency of an electrical signal is lower than speech frequency, a diaphragm 25 is combined with a diaphragm 18 and it operates. In this case, shaker 10G operate as a shaker literally, and vibrate the vibrated body 11. When the frequency of an electrical signal is higher than speech frequency, it dissociates as acoustically as a diaphragm 25 and a diaphragm 18 vibrates greatly.

[0078] Furthermore, with the gestalt of this operation, the sound pressure generated by vibration of a diaphragm 18 is led to the acoustic resonator constituted with a vacant room C2 and tubing 28 through 15d of paths, as shown in an arrow head f. For this reason, when operating shaker 10G as the sounding body, according to the resonance phenomenon of an acoustic resonator, sound pressure level increases and the bigger sound reproduction of it becomes possible.

[0079] (Gestalt 7 of operation) It explains, referring to drawing 8 - drawing 10 about the excitation equipment in the gestalt 7 of the operation of this invention to a degree. Drawing 8 is the connection diagram of the shaker 10 of the gestalt of this operation, and the electrical signal generator 30 and the acoustic signal generation circuit 31 which drive a shaker 10 in excitation mode. The excitation signal which is the shaker shown with the gestalten 1-6 of operation, and is generated with the electrical signal generator 30 shall be inputted into a shaker 10, and a shaker 10 shall operate.

[0080] The reaction force generated in the magnetic-circuit section of a shaker 10 serves as max with the mechanical lowest resonance frequency fo. And the vibrated body 11 can be excited most greatly in the neighborhood of this frequency band. Therefore, the electrical signal which had the predetermined bandwidth centering on lowest resonance frequency fo as the electrical signal generator 30 showed to drawing 9 is generated. And even when dispersion is in lowest resonance frequency fo by inputting this signal into a shaker 10 at the time of the mass production of a shaker 10, target exciting force can be acquired.

[0081] As an electrical signal with frequency bandwidth, as shown in drawing 10 , it is the range which contains the lowest frequency fo of a shaker using a sinusoidal signal, and if it considers as the signal with which the sweep of the frequency is carried out in time, the moment sweep frequency was in agreement with lowest resonance frequency fo, the reaction force generated in the magnetic-circuit section of a shaker 10 will serve as max. And the vibrated body 11 can be most greatly excited on this frequency. In addition, the effectiveness that either is the same is acquired the lower one from the one from the one where a frequency is lower where the direction of a sweep is higher, or the higher one. Moreover, after one round term of a frequency is completed, even if the wave of a sine wave is a wave which leads to a round term of the following frequency continuously, it may be a wave from which a period changes continuously with time amount. When it uses for a cellular phone, since the way [it carries out to a multiple-times continuation target and carries out the sweep of multiple times again after the pause for 1 - 2 seconds] senses a sweep for the body as change of a big tactile sense, it is more desirable.

[0082] Drawing 11 is the circuit diagram showing other examples of the electrical signal generator 40. In this Fig., 41 is a square wave signal generating circuit, and the output is inputted into the switching circuit which consists of a transistor 42. As for 43 and 44, the resistance for bias of the transistor 42 for switching and 45 are dc-batteries. A transistor 42 will be in ON condition on an electrical potential difference Vin (V), and this electrical signal generator 40 is output voltage Vout in an outgoing end, if a square wave signal is inputted into a transistor 42 from a square wave generator 41. It generates. Next, if an input wave is set to 0 (V), a transistor 42 will be in an OFF condition and an output wave will also be set to 0 (V). Therefore, if a period makes a square wave signal in time the square wave signal by which a sweep is carried out, a period will serve as a signal by which the sweep was carried out and an output wave will also add this signal to a shaker 10, the moment the sweep period was in agreement with lowest

resonance frequency fo, the reaction force generated in the magnetic-circuit section of a shaker 10 will serve as max. And the vibrated body 11 can be most greatly excited on this frequency. Although it is the same as that of the case of the sinusoidal signal of drawing 10 , since this operation is using the dc-battery of the terminal for mobile communications, such as a cellular phone, as the power source, it has the description that the driving signal of a shaker can be easily made from ON-OFF of battery voltage, and is more practical.

[0083] In addition, although the input signal to a transistor 42 was made into the square wave with the gestalt of this operation, it is good also as a sine wave. Also in this case, a transistor 42 can carry out ON-OFF actuation, and can generate the output signal of a square wave.

[0084] Although a shaker 10 pronounces in vibration and a speech frequency band in a low frequency region, if it is made to vibrate by the square wave signal of low frequency, a loud sound will occur with vibration for the frequency component of the higher harmonic which a square wave has. Since the pronunciation by this harmonic content becomes the bent thing, as for harmonic content, cutting electrically is desirable. The electrical signal generator with which drawing 12 shows the circuit for it, and 40 carries out a square wave, and 51 are [a low pass filter (LPF) and 52] signal change-over switches. The electrical signal generator 40 will generate a square wave signal, if the control signal which is not illustrated is inputted. Although not displayed here, the signal change-over switch 52 is connected to a low pass filter 51 side, when interlocking and switching to an input signal and vibrating it. The harmonic content which a square wave signal contains is not cut, the electrical signal which does not contain harmonic content is inputted into a shaker 10, and a low pass filter 51 prevents that a distortion sound is reproduced at the time of actuation of vibration. Moreover, at the time of playback of a sound, the signal change-over switch 52 switches, the output of the acoustic signal generation circuit 31 is connected to the direct shaker 10, and it becomes reproducible [without the reproducible effect of a low pass filter 51]. In addition, comparatively low 150-200Hz or less of people's acoustic-sense sensibility of the treble cut off frequency of a low pass filter 51 is desirable.

[0085] Moreover, although the signal added as an object for oscillating playback of a shaker with the gestalt of this operation was a sine wave or a square wave, as long as the resonance frequency of vibration is included, the random-noise signal which has frequency bandwidth, for example, or a music signal is sufficient as it.

[0086] (Gestalt 8 of operation) It explains, referring to drawing 13 about the personal digital assistant equipment in the gestalt 8 of the operation of this invention to a degree. Drawing 13 is the sectional view showing the structure of personal digital assistant equipment. When personal digital assistant equipment considers as a cellular phone, it is constituted including a housing 61, the transceiver circuit which is not illustrated, a voice-input/output circuit, a key input circuit, etc. Here, the arrival of a cellular phone shall be told to a user by vibration of the housing 61 instead of a sound. For this reason, the shaker 10 of the gestalten 1-7 of operation is attached in some housings 61. The shaker 10 of the gestalt of this operation performs excitation and a voice output, as mentioned above. Opening 61a is prepared in a housing 61, and the voice of a shaker 10 is emitted from this opening 61a.

[0087] If the electrical signal of a frequency lower than speech frequency is added to a shaker 10, vibration of a shaker 10 will be transmitted to a housing 61 through a frame 15. When the user puts in and possesses this personal digital assistant equipment in the pocket of clothes etc., vibration of a housing 61 can be sensed corporally. On the other hand, if the electrical signal of speech frequency is added, a shaker 10 will operate as the sounding body and ringer tone voice will be outputted to the exterior of a box 61 outside through opening 61a like an arrow head g.

[0088] Although components with separate shaker and sounding body constituted from the conventional cellular phone, both actuation with excitation and pronunciation can be performed by using the shaker of this invention. For this reason, while realizing a miniaturization and lightweight-izing of personal digital assistant equipment, low-pricing by reduction of components mark is attained.

[0089] In addition, although the cellular phone was made into the example as personal digital assistant equipment in drawing 13 , even if it uses a pager etc. for other personal digital assistant equipments, it cannot be overemphasized that an equivalent function is obtained. Moreover, although the gestalt of this operation has not described the electrical signal inputted into the shaker attached in personal digital assistant equipment, it cannot be overemphasized that it is desirable to drive with drawing 8 and the electrical signal generators 30 and 40 stated by 9, 10, 11, and 12. Furthermore, the device to attach may not be limited to personal digital assistant equipment, either, and may be used for the various devices which need playback of vibration and a sound, for example, audio equipment, and a game device.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the structure of the shaker in the gestalt 1 (the 1) of operation of this invention.
[Drawing 2] It is the sectional view showing the structure of the shaker in the gestalt 1 (the 2) of operation of this invention.
[Drawing 3] It is the sectional view showing the structure of the shaker in the gestalt 2 of operation of this invention.
[Drawing 4] It is the sectional view showing the structure of the shaker in the gestalt 3 of operation of this invention.
[Drawing 5] It is the sectional view showing the structure of the shaker in the gestalt 4 of operation of this invention.
[Drawing 6] It is the sectional view showing the structure of the shaker in the gestalt 5 of operation of this invention.
[Drawing 7] It is the sectional view showing the structure of the shaker in the gestalt 6 of operation of this invention.
[Drawing 8] It is the block diagram showing the excitation equipment in the gestalt 7 of operation of this invention.
[Drawing 9] It is the frequency-characteristics Fig. of the excitation signal in the gestalt 7 of operation of this invention.
[Drawing 10] It is the wave form chart of the excitation signal in the gestalt 7 of operation of this invention.
[Drawing 11] It is the circuit diagram of the electrical signal generator in the gestalt 7 of operation of this invention.
[Drawing 12] It is the block diagram of the excitation equipment in the gestalt 7 of operation of this invention.
[Drawing 13] It is the sectional view showing the structure of the personal digital assistant equipment in the gestalt 8 of operation of this invention.
[Drawing 14] It is the sectional view showing the structure of the electrodynamic type converter which is one of the conventional shakers.
[Description of Notations]
10, 10A-10G Shaker
11 Vibrated Body
12 York
13 Magnet
14 Senter Pole
15 Frame
15a, 15b, 15d Path
15c, 15y Supporting point
15x, 31a Opening
15A The 1st frame
15B The 2nd frame
15C The 3rd frame
16 Voice Coil Bobbin
17 Excitation Coil
18 Diaphragm
18a Dome section
19 Edge
20 Spring
21, 24, 27 Load mass
22 25 The 2nd diaphragm
22a, 25a The 2nd edge
23 26 Lever
24 2nd Frame
29 3rd Frame
28 Tubing (Acoustic Resonance Tubing)

30 40 Electrical signal generator
31 Acoustic Signal Generation Circuit
41 Square Wave Signal Generating Circuit
51 Low Pass Filter
52 Signal Change-over Switch
61 Box of Cellular Phone
C, C1, C2 Vacant room

[Translation done.]

* NOTICES *

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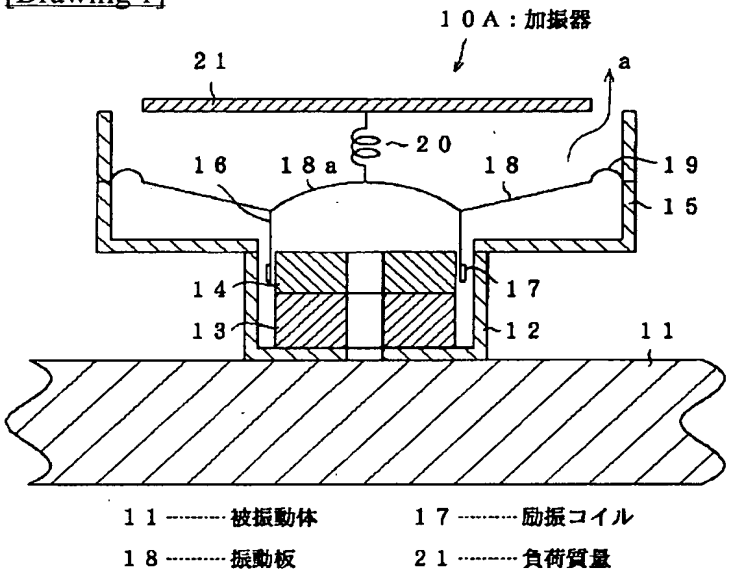
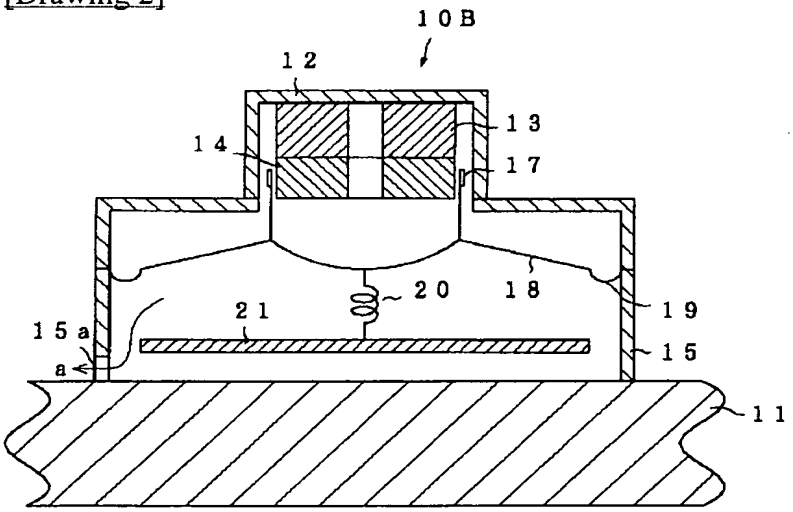
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

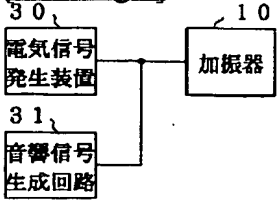
[Drawing 1]



[Drawing 2]



[Drawing 8]



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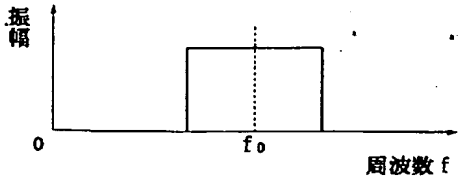
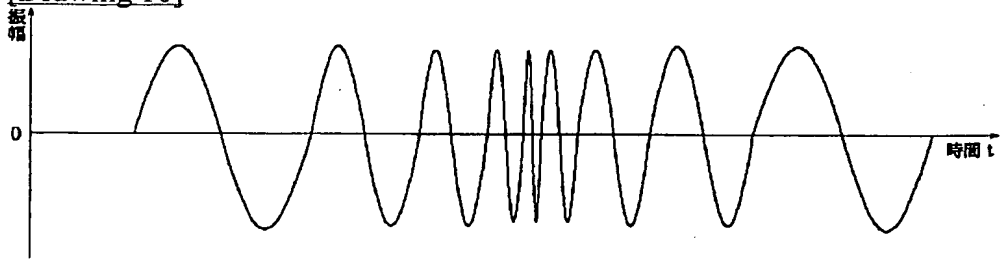
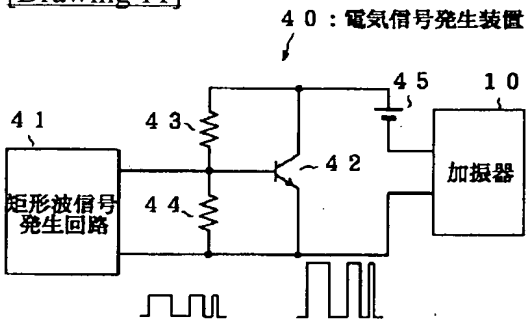


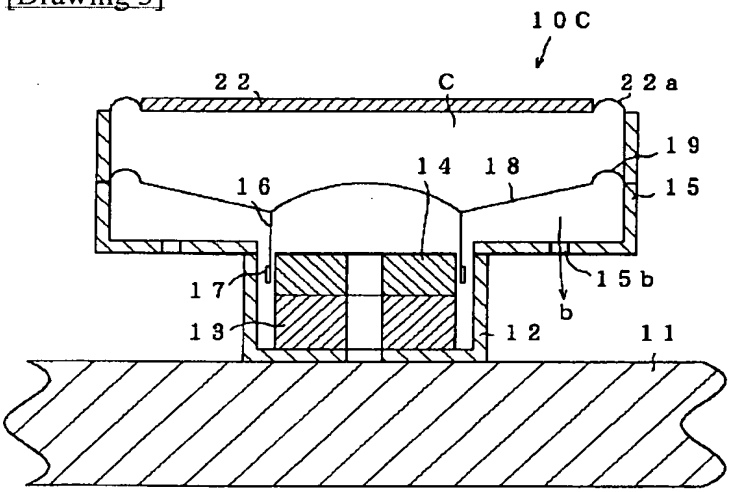
[Drawing 10]



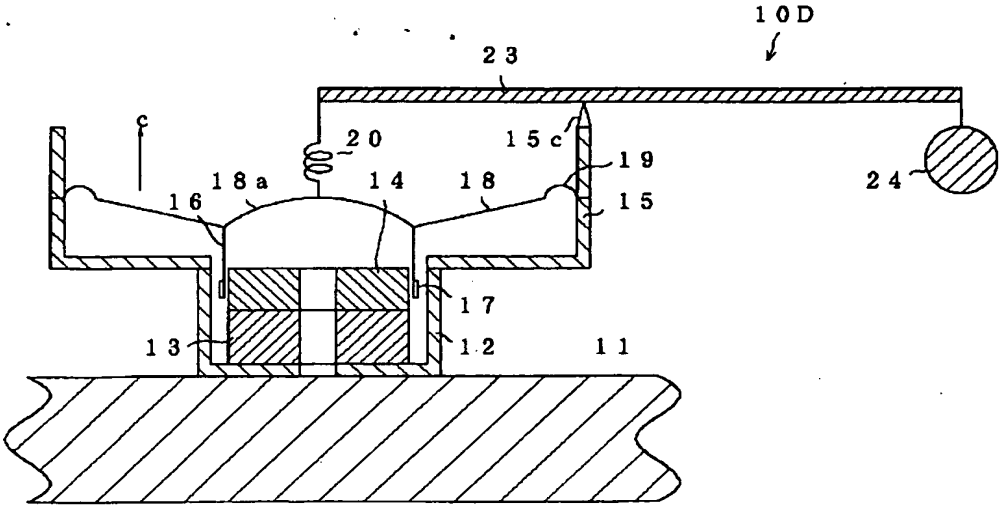
[Drawing 11]



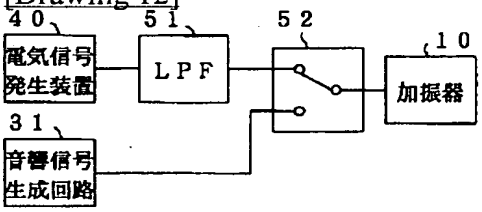
[Drawing 3]



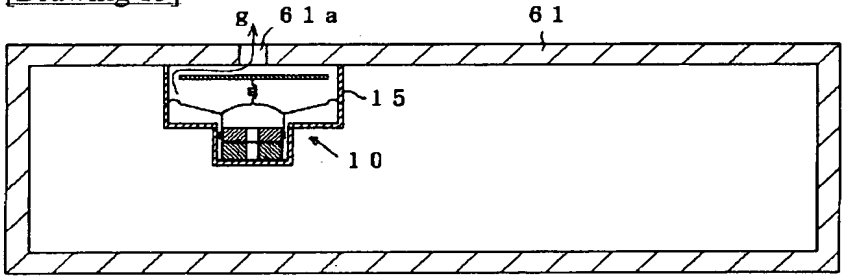
[Drawing 4]



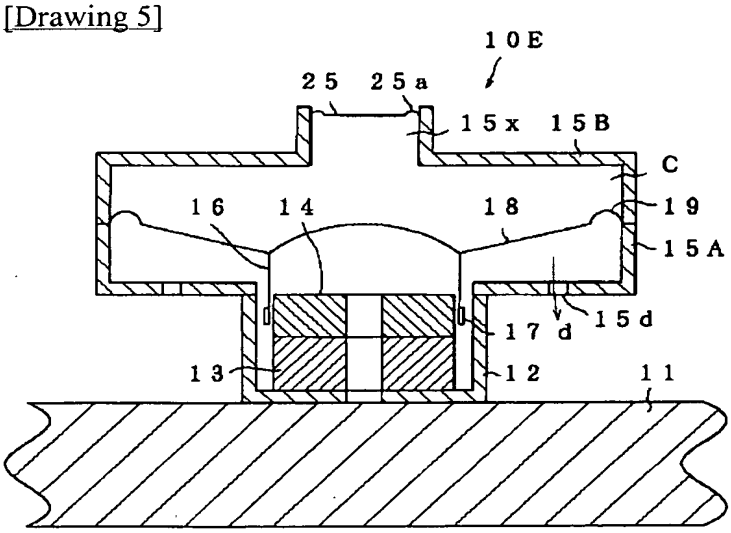
[Drawing 12]



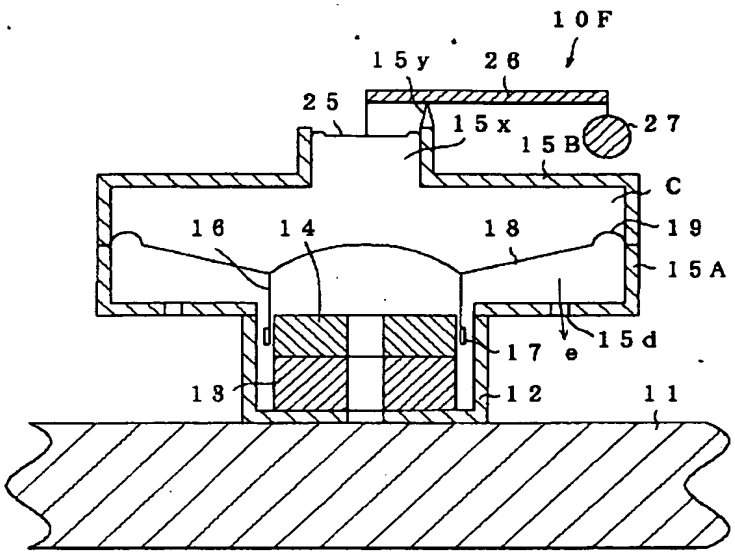
[Drawing 13]



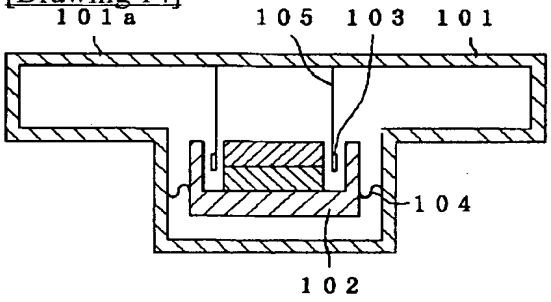
[Drawing 5]



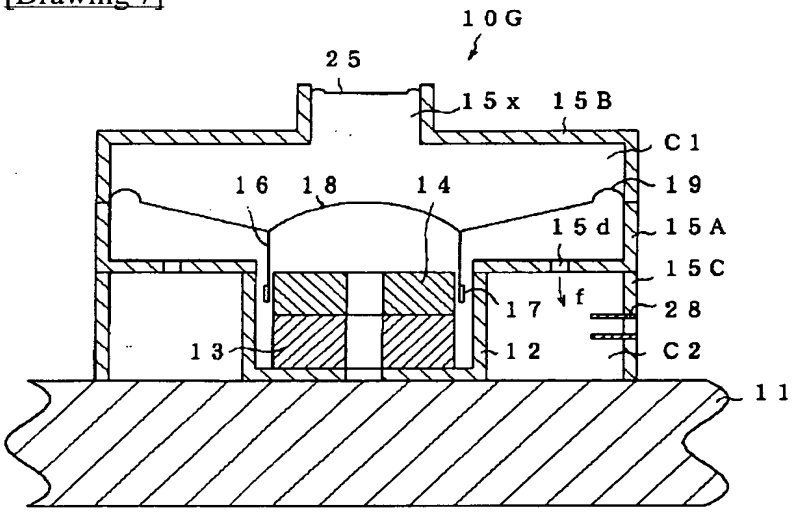
[Drawing 6]



[Drawing 14]



[Drawing 7]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（A）　(11)特許出願公開番号

特開平10－93672

(43)公開日　平成10年(1998)４月10日

(51)Int.Cl.[6]		識別記号	FI		
Ｈ０４Ｍ	1/03		Ｈ０４Ｍ	1/03	Ｃ
Ｂ０６Ｂ	1/04		Ｂ０６Ｂ	1/04	Ｓ
Ｈ０４Ｍ	1/00		Ｈ０４Ｍ	1/00	Ｋ
Ｈ０４Ｒ	1/00	３１０	Ｈ０４Ｒ	1/00	３１０Ｇ

審査請求　有　　請求項の数25　ＯＬ　（全 15 頁）

(21)出願番号　特願平9－108875

(22)出願日　平成９年(1997)４月25日

(31)優先権主張番号　特願平8－130986

(32)優先日　平８(1996)４月25日

(33)優先権主張国　日本（ＪＰ）

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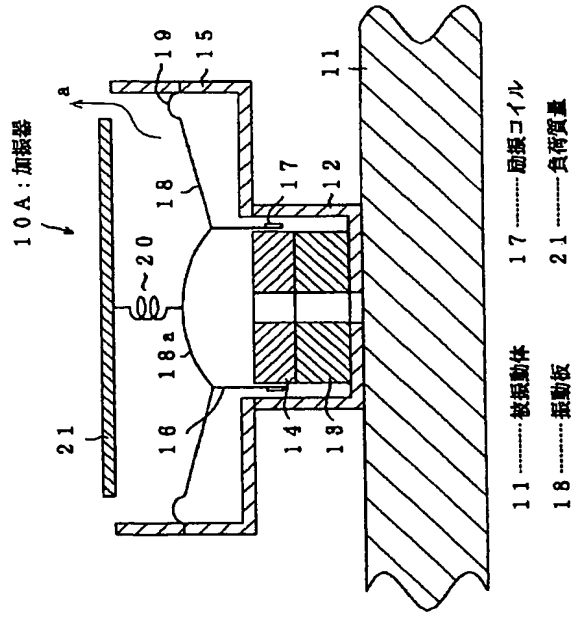
(54)【発明の名称】　加振器、加振装置及び携帯端末装置

(57)【要約】

【課題】　コンプライアンスを介して振動板に負荷質量を結合させることにより、低い周波数では加振器として動作し、高い周波数では発音体として動作する加振器を実現すること。

【解決手段】　スピーカと同様に固定部として、ヨーク１２、マグネット１３、センタポール１４からなる磁気回路部を設け、可動部として励振コイル１７を回巻きしたボイスコイルボビン１６、振動板１８を設ける。そして振動板１８の中央に、ばね２０を介して負荷質量２１を取り付ける。振動板１８が低周波で振動したとき、ばね２０はコンプライアンスとして作用し、負荷質量２１の慣性によりフレーム１５が反力を受けて振動する。また音声帯域の信号が入力されたとき、スピーカとして作用し、音声が前方から出力される。



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【特許請求の範囲】

【請求項１】　少なくとも低周波及び音声周波数帯で振動する振動板と、

前記振動板にボビンを介して取付けられた励振コイルと、

前記励振コイルに電磁駆動力を与える磁気回路と、

所定の質量を有する慣性負荷と、

前記振動板と前記慣性負荷との間に設けられたコンプライアンスと、を具備し、

前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記慣性負荷と前記振動板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加されたとき、前記コンプライアンスにより前記振動板が振動し発音するようにしたことを特徴とする加振器。

【請求項２】　前記コンプライアンスは、

前記振動板と前記慣性負荷に接続されたばねであることを特徴とする請求項１記載の加振器。

【請求項３】　少なくとも低周波及び音声周波数帯で振動する第１の振動板と、

前記第１の振動板にボビンを介して取付けられた励振コイルと、

前記励振コイルに電磁駆動力を与える磁気回路と、

前記第１の振動板を支持するフレームに対して振動自在に保持され、前記第１の振動板より低い固有振動数を持つ第２の振動板と、

前記第１の振動板と前記第２の振動板との間に設けられたコンプライアンスと、を具備し、

前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記第１の振動板と前記第２の振動板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加されたとき、前記コンプライアンスにより前記第１の振動板が振動し発音するようにしたことを特徴とする加振器。

【請求項４】　前記コンプライアンスは、

前記第１の振動板と前記第２の振動板と前記フレームとで密閉された空気室であることを特徴とする請求項３記載の加振器。

【請求項５】　少なくとも低周波及び音声周波数帯で振動する振動板と、

前記振動板にボビンを介して取付けられた励振コイルと、

前記励振コイルに電磁駆動力を与える磁気回路と、

所定の質量を有する慣性負荷と、

前記慣性負荷の質量を振動系を介して変換する機械的変成器と、

前記機械的変成器の１次側と前記振動板との間に設けられたコンプライアンスと、を具備し、

前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記慣性負荷と前記振動板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加

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されたとき、前記コンプライアンスにより前記振動板が振動し発音するようにしたことを特徴とする加振器。

【請求項６】　前記コンプライアンスは、

前記振動板と前記機械的変成器の１次側に接続されたばねであることを特徴とする請求項５記載の加振器。

【請求項７】　前記機械的変成器は、

一端に前記コンプライアンスが取付けられ、他端に前記慣性負荷が取付けられ、前記第１の振動板を支持するフレームに支点があるてこであることを特徴とする請求項５記載の加振器。

【請求項８】　少なくとも低周波及び音声周波数帯で振動する第１の振動板と、

前記第１の振動板にボビンを介して取付けられた励振コイルと、

前記励振コイルに電磁駆動力を与える磁気回路と、

前記第１の振動板を支持するフレームに対して振動自在に保持され、前記第１の振動板より有効面積の小さい第２の振動板と、

前記第１の振動板と前記第２の振動板との間に設けられたコンプライアンスと、を具備し、

前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記第１の振動板と前記第２の振動板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加されたとき、前記コンプライアンスにより前記第１の振動板が振動し発音するようにしたことを特徴とする加振器。

【請求項９】　前記コンプライアンスは、

前記第１の振動板と前記第２の振動板と前記フレームとで密閉された空気室であることを特徴とする請求項８記載の加振器。

【請求項１０】　前記第２の振動板は、

前記空気室を介して前記第１の振動板の振動負荷を増大させる音響的変成器を構成するものであることを特徴とする請求項９記載の加振器。

【請求項１１】　少なくとも低周波及び音声周波数帯で振動する第１の振動板と、

前記第１の振動板にボビンを介して取付けられた励振コイルと、

前記励振コイルに電磁駆動力を与える磁気回路と、

前記第１の振動板を支持するフレームに対して振動自在に保持され、前記第１の振動板より有効面積の小さい第２の振動板と、

前記第１の振動板と前記第２の振動板との間に設けられたコンプライアンスと、

所定の質量を有する慣性負荷と、

前記慣性負荷の質量を振動系を介して変換し、変換負荷を前記第２の振動板に与える機械的変成器と、を具備し、

前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記第１の振動板と前記第２の振動

板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加されたとき、前記コンプライアンスにより前記第１の振動板が振動し発音するようにしたことを特徴とする加振器。

【請求項１２】　前記コンプライアンスは、

前記第１の振動板と前記第２の振動板と前記フレームとで密閉された空気室であることを特徴とする請求項１１記載の加振器。

【請求項１３】　前記機械的変成器は、

一端に前記コンプライアンスが取付けられ、他端に前記慣性負荷が取付けられ、前記第１の振動板を支持するフレームに支点があるてこであることを特徴とする請求項１１記載の加振器。

【請求項１４】　少なくとも低周波及び音声周波数帯で振動する第１の振動板と、

前記第１の振動板にボビンを介して取付けられた励振コイルと、

前記励振コイルに電磁駆動力を与える磁気回路と、

前記第１の振動板を支持するフレームに対して振動自在に保持され、前記第１の振動板より有効面積の小さい第２の振動板と、

前記第１の振動板と前記第２の振動板との間に設けられ、密閉された第１の空気室と、

前記第１の空気室で発生した空気振動を入力して滞留させ、管を経て外部に空気振動を出力させる第２の空気室と、を具備し、

前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記第１の振動板と前記第２の振動板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加されたとき、前記コンプライアンスにより前記第１の振動板が振動し発音するようにしたことを特徴とする加振器。

【請求項１５】　請求項１～１４記載の加振器と、

少なくとも振動の共振周波数を含む所定の周波数帯域幅を持った電気信号を前記加振器に入力する電気信号発生装置と、を具備することを特徴とする加振装置。

【請求項１６】　請求項１～１４記載の加振器と、

少なくとも振動の共振周波数を含み時間的に周波数を掃引する電気信号を前記加振器に入力する電気信号発生装置と、を具備することを特徴とする加振装置。

【請求項１７】　前記電気信号発生装置は、掃引により周波数の変化する正弦波信号を発生するものであることを特徴とする請求項１６記載の加振装置。

【請求項１８】　前記電気信号発生装置は、掃引により周波数の変化する矩形波信号を発生するものであることを特徴とする請求項１６記載の加振装置。

【請求項１９】　前記電気信号発生装置の出力側に再生する音声周波数より低い周波数を遮断周波数とするローパスフィルタを設けたことを特徴とする請求項１８記載の加振装置。

【請求項２０】　前記励振コイルは、前記慣性負荷の共振周波数を含む所定の帯域幅の加振信号により駆動されることを特徴とする請求項１，２，５，６，７のいずれか１項記載の加振器。

【請求項２１】　前記励振コイルは、前記第２の振動板の共振周波数を含む所定の帯域幅の加振信号により駆動されることを特徴とする請求項３，４，８～１４のいずれか１項記載の加振器。

【請求項２２】　前記励振コイルは、前記慣性負荷の共振周波数を含む所定範囲で掃引される加振信号により駆動されることを特徴とする請求項１，２，５，６，７のいずれか１項記載の加振器。

【請求項２３】　前記励振コイルは、前記第２の振動板の共振周波数を含む所定範囲で掃引される加振信号により駆動されることを特徴とする請求項３，４，８～１４のいずれか１項記載の加振器。

【請求項２４】　請求項１～１４，２０～２３のいずれか１項記載の加振器を具備したことを特徴とする携帯端末装置。

【請求項２５】　請求項１５～１９のいずれか１項記載の加振装置を具備したことを特徴とする携帯端末装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は発音機能を兼ね備えた加振器、加振装置と加振器又は加振装置を取付けた携帯端末装置に関するものである。

【０００２】

【従来の技術】従来の動電型加振器の一例について説明する。図１４は従来の動電型加振器の構造を示す断面図であり、筐体１０１、磁気回路１０２、励振コイル１０３、ダンパー１０４、ボイスコイルボビン１０５を含んで構成される。筐体１０１は加振器自体の筐体か、携帯端末装置と共通になった筐体である。筐体１０１の一部には平板部１０１ａが形成されている。ボイスコイルボビン１０５は下端部が励振コイル１０３により回巻きされ、上端部が筐体の振動部１０１ａに固着された状態となっている。

【０００３】このような構成の動電型加振器において、励振コイル１０３に交流の電気信号が印加されると、励振コイル１０３と磁気回路１０２との間に電磁力が発生し、ボイスコイルボビン１０５が軸方向に振動する。センタポールとヨークとを含む磁気回路１０２は、ダンパー１０４を介して筐体１０１の下側で振動自在に保持されている。このため磁気回路１０４と筐体１０１が共に電磁力の反作用により互いに振動する。筐体１０１の振動は平板部１０１ａを通してこの動電型加振器を身に付けた使用者に伝達される。

【０００４】

【発明が解決しようとする課題】しかしながら、このような従来の動電型加振器では、共振鋭度が振動系の質量

に比例するため、共振周波数付近で大きな力を得るためには、磁気回路１０２の質量を大きくしなければならない。こうすると加振器全体の重量が非常に大きなものになるという欠点があった。

【０００５】又磁気回路１０２の質量を大きくすると、磁気回路自身の振動が小さくなり磁気回路１０２から音が発生しにくくなり、発音体として効率が悪くなるという問題があった。

【０００６】本発明は、このような従来の問題点に鑑みてなされたものであって、動電変換型の振動板と、振動板に付加させる負荷質量との間にコンプライアンスを介することにより、低い周波数では加振器として動作させ、高い周波数では発音体として動作させる加振器を実現することを目的とする。更には、変成器を設けることにより、負荷質量の見かけ上の重量を低減し、加振器全体の重量増加を抑えることを目的としている。

【０００７】

【課題を解決するための手段】このような課題を解決するため、本願の請求項１記載の発明は、少なくとも低周波及び音声周波数帯で振動する振動板と、前記振動板にボビンを介して取付けられた励振コイルと、前記励振コイルに電磁駆動力を与える磁気回路と、所定の質量を有する慣性負荷と、前記振動板と前記慣性負荷との間に設けられたコンプライアンスと、を具備し、前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記慣性負荷と前記振動板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加されたとき、前記コンプライアンスにより前記振動板が振動して発音するようにしたことを特徴とするものである。

【０００８】又本願の請求項２記載の発明では、請求項１記載の加振器において、前記コンプライアンスは、前記振動板と前記慣性負荷に接続されたばねであることを特徴とするものである。

【０００９】このような構成によれば、励振コイルに音声周波数より低い交流信号が印加されたとき、慣性負荷と振動板とが一体に振動する。このとき磁気回路とこれを保持しているフレームに反力が生じ、この反力が被振動体に伝わる。又励振コイルに音声信号が印加されたとき、コンプライアンスにより振動板のみが振動し、音声が外部に放射される。従って１つの装置で加振器と発音体の両機能が達成される。

【００１０】又本願の請求項３記載の発明は、少なくとも低周波及び音声周波数帯で振動する第１の振動板と、前記第１の振動板にボビンを介して取付けられた励振コイルと、前記励振コイルに電磁駆動力を与える磁気回路と、前記第１の振動板を支持するフレームに対して振動自在に保持され、前記第１の振動板より低い固有振動数を持つ第２の振動板と、前記第１の振動板と前記第２の振動板との間に設けられたコンプライアンスと、を具備し、前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記第１の振動板と前記第２の振動板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加されたとき、前記コンプライアンスにより前記第１の振動板が振動し発音するようにしたことを特徴とするものである。

【００１１】又本願の請求項４記載の発明では、請求項３記載の加振器において、前記コンプライアンスは、前記第１の振動板と前記第２の振動板と前記フレームとで密閉された空気室であることを特徴とするものである。

【００１２】このような構成によれば、励振コイルに音声周波数より低い交流信号が印加されたとき、第１の振動板と第２の振動板とが一体に振動する。このとき磁気回路とこれを保持しているフレームに反力が生じ、この反力が被振動体に伝わる。励振コイルに音声信号が印加されたとき、前記コンプライアンスにより前記第１の振動板のみが振動し、音声が外部に放射される。従って１つの装置で加振器と発音体の両機能が達成される。又第１の振動板に局部的な応力が加わらない。

【００１３】又本願の請求項５記載の発明は、少なくとも低周波及び音声周波数帯で振動する振動板と、前記振動板にボビンを介して取付けられた励振コイルと、前記励振コイルに電磁駆動力を与える磁気回路と、所定の質量を有する慣性負荷と、前記慣性負荷の質量を振動系を介して変換する機械的変成器と、前記機械的変成器の１次側と前記振動板との間に設けられたコンプライアンスと、を具備し、前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記慣性負荷と前記振動板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加されたとき、前記コンプライアンスにより前記第１の振動板が振動し発音するようにしたことを特徴とするものである。

【００１４】又本願の請求項６記載の発明では、請求項５記載の加振器において、前記コンプライアンスは、前記振動板と前記機械的変成器の１次側に接続されたばねであることを特徴とするものである。

【００１５】又本願の請求項７記載の発明では、請求項５記載の加振器において、前記機械的変成器は、一端に前記コンプライアンスが取付けられ、他端に前記慣性負荷が取付けられ、前記第１の振動板を支持するフレームに支点があるてこであることを特徴とするものである。

【００１６】このような構成によれば、励振コイルに音声周波数より低い交流信号が印加されたとき、慣性負荷と振動板とが機械的変成器を介して一体に振動する。このとき磁気回路とこれを保持しているフレームに反力が生じ、この反力が被振動体に伝わる。励振コイルに音声信号が印加されたとき、コンプライアンスにより第１の振動板のみが振動し、音声が外部に放射される。従って１つの装置で加振器と発音体の両機能が達成される。又慣性負荷の質量は請求項１、２記載のものより小さくて済む。

【００１７】又本願の請求項８記載の発明は、少なくとも低周波及び音声周波数帯で振動する第１の振動板と、前記第１の振動板にボビンを介して取付けられた励振コイルと、前記励振コイルに電磁駆動力を与える磁気回路と、前記第１の振動板を支持するフレームに対して振動自在に保持され、前記第１の振動板より有効面積の小さい第２の振動板と、前記第１の振動板と前記第２の振動板との間に設けられたコンプライアンスと、を具備し、前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記第１の振動板と前記第２の振動板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加されたとき、前記コンプライアンスにより前記第１の振動板が振動し発音するようにしたことを特徴とするものである。

【００１８】又本願の請求項９記載の発明では、請求項８記載の加振器において、前記コンプライアンスは、前記第１の振動板と前記第２の振動板と前記フレームとで密閉された空気室であることを特徴とするものである。

【００１９】又本願の請求項１０記載の発明では、請求項８記載の加振器において、前記第２の振動板は、前記空気室を介して前記第１の振動板の振動負荷を増大させる音響的変成器を構成することを特徴とするものである。

【００２０】このような構成によれば、励振コイルに音声周波数より低い交流信号が印加されたとき、第１の振動板と第２の振動板とがコンプライアンスを介して一体に振動する。このとき磁気回路とこれを保持しているフレームに反力が生じ、この反力が被振動体に伝わる。励振コイルに音声信号が印加されたとき、コンプライアンスにより第１の振動板のみが振動し、音声が外部に放射される。従って１つの装置で加振器と発音体の両機能が達成される。又第２の振動板は小面積でよく、第１の振動板に局部的な応力が加わらない。

【００２１】又本願の請求項１１記載の発明は、少なくとも低周波及び音声周波数帯で振動する第１の振動板と、前記第１の振動板にボビンを介して取付けられた励振コイルと、前記励振コイルに電磁駆動力を与える磁気回路と、前記第１の振動板を支持するフレームに対して振動自在に保持され、前記第１の振動板より有効面積の小さい第２の振動板と、前記第１の振動板と前記第２の振動板との間に設けられたコンプライアンスと、所定の質量を有する慣性負荷と、前記慣性負荷の質量を振動系を介して変換し、変換負荷を前記第２の振動板に与える機械的変成器と、を具備し、前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記第１の振動板と前記第２の振動板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加されたとき、前記コンプライアンスにより前記第１の振動板が振動し発音するようにしたことを特徴とするものである。

【００２２】又本願の請求項１２記載の発明では、請求項１１記載の加振器において、前記コンプライアンスは、前記第１の振動板と前記第２の振動板と前記フレームとで密閉された空気室であることを特徴とするものである。

【００２３】又本願の請求項１３記載の発明では、請求項１１記載の加振器において、前記機械的変成器は、一端に前記コンプライアンスが取付けられ、他端に前記慣性負荷が取付けられ、前記第１の振動板を支持するフレームに支点があるてこであることを特徴とするものである。

【００２４】このような構成によれば、励振コイルに音声周波数より低い交流信号が印加されたとき、第１の振動板と第２の振動板と慣性負荷とが一体に振動する。このとき磁気回路とこれを保持しているフレームに反力が生じ、この反力が被振動体に伝わる。励振コイルに音声信号が印加されたとき、コンプライアンスにより第１の振動板のみが振動し、音声が外部に放射される。従って１つの装置で加振器と発音体の両機能が達成される。又第２の振動板は小面積でよく、第１の振動板に局部的な応力が加わらない。慣性負荷の質量は請求項５～７記載のものより更に小さくて済む。

【００２５】又本願の請求項１４記載の発明は、少なくとも低周波及び音声周波数帯で振動する第１の振動板と、前記第１の振動板にボビンを介して取付けられた励振コイルと、前記励振コイルに電磁駆動力を与える磁気回路と、前記第１の振動板を支持するフレームに対して振動自在に保持され、前記第１の振動板より有効面積の小さい第２の振動板と、前記第１の振動板と前記第２の振動板との間に設けられ、密閉された第１の空気室と、前記第１の空気室で発生した空気振動を入力して滞留させ、管を経て外部に空気振動を出力させる第２の空気室と、を具備し、前記励振コイルに音声周波数より低い周波数の交流信号が印加されたとき、前記第１の振動板と前記第２の振動板とが一体に振動し、前記励振コイルに音声周波数帯の信号が印加されたとき、前記コンプライアンスにより前記第１の振動板が振動し発音するようにしたことを特徴とするものである。

【００２６】このような構成によれば、励振コイルに音声周波数より低い交流信号が印加されたとき、第１の振動板と第２の振動板とがコンプライアンスを介して一体に振動する。このとき磁気回路とこれを保持しているフレームに反力が生じ、この反力が被振動体に伝わる。励振コイルに音声信号が印加されたとき、コンプライアンスにより第１の振動板のみが振動する。この音圧は第２の空気室と結合された管を経て出力されるので、音響共鳴現象によって音圧レベルはより増大される。又１つの装置で加振器と発音体の両機能が達成される。更に第２の振動板は小面積でよく、第１の振動板に局部的な応力が加わらない。

【００２７】又本願の請求項１５記載の発明は、請求項

１～１４記載の加振器と、少なくとも振動の共振周波数を含む所定の周波数帯域幅を持った電気信号を前記加振器に入力する電気信号発生装置と、を具備することを特徴とするものである。

【００２８】又本願の請求項１６記載の発明は、請求項１～１４記載の加振器と、少なくとも振動の共振周波数を含み時間的に周波数を掃引する電気信号を前記加振器に入力する電気信号発生装置と、を具備することを特徴とするものである。

【００２９】又本願の請求項１７記載の発明では、請求項１６記載の加振装置において、前記電気信号発生装置は、掃引により周波数の変化する正弦波信号を発生することを特徴とするものである。

【００３０】又本願の請求項１８記載の発明では、請求項１６記載の加振装置において、前記電気信号発生装置は、掃引により周波数の変化する矩形波信号を発生することを特徴とするものである。

【００３１】又本願の請求項１９記載の発明は、請求項１８記載の加振装置において、前記電気信号発生装置の出力側に再生する音声周波数より低い周波数を遮断周波数とするローパスフィルタを設けたことを特徴とするものである。

【００３２】又本願の請求項２０記載の発明では、請求項１，２，５，６，７の加振器において、前記励振コイルは、前記慣性負荷の共振周波数を含む所定の帯域幅の加振信号により駆動されることを特徴とするものである。

【００３３】又本願の請求項２１記載の発明では、請求項３，４，８～１４の加振器において、前記励振コイルは、前記第２の振動板の共振周波数を含む所定の帯域幅の加振信号により駆動されることを特徴とするものである。

【００３４】又本願の請求項２２記載の発明では、請求項１，２，５，６，７の加振器において、前記励振コイルは、前記慣性負荷の共振周波数を含む所定範囲で掃引される加振信号により駆動されることを特徴とするものである。

【００３５】又本願の請求項２３記載の発明では、請求項３，４，８～１４の加振器において、前記励振コイルは、前記第２の振動板の共振周波数を含む所定範囲で掃引される加振信号により駆動されることを特徴とするものである。

【００３６】又本願の請求項２４記載の携帯端末装置では、請求項１～１４，２０～２３のいずれか１項記載の加振器を具備したことを特徴とするものである。

【００３７】又本願の請求項２５記載の携帯端末装置では、請求項１５～１９のいずれか１項記載の加振装置を具備したことを特徴とするものである。

【００３８】このような構成によれば、共振器の加振モードにおける共振周波数のばらつきあっても、第１の振動板と第２の振動板又は慣性負荷とは確実に共振する。

【００３９】

【発明の実施の形態】

（実施の形態１）本発明の実施の形態１（その１）における加振器について図１を参照しながら説明する。図１は本実施の形態の加振器１０Ａの構造を示す断面図である。この加振器１０Ａは筐体の一部である被振動体１１に固着された構造となっており、固定部としてヨーク１２、マグネット１３、センターポール１４、フレーム１５を有し、可動部としてボイスコイルボビン１６、励振コイル１７、振動板１８を有している。

【００４０】ヨーク１２は磁性金属でカップ状に加工されたもので、その中心軸に沿って円板状のマグネット１３とセンタポール１４とが積層して固着されている。ここではマグネット１３とセンタポール１４とは中空になっている。センタポール１４の外周部とヨーク１２の内周部が形成する空隙は磁気ギャップを形成し、ボイスコイルボビン１６の外周部に回巻きされた励振コイル１７がこの磁気ギャップ中に保持されている。

【００４１】振動板１８は、外周部が円錐状に、内周部がドーム状に一体形成されたものであり、フレーム１５に対してエッジ１９を介して振動自在に保持されている。振動板１８の中央部をドーム部１８ａとすると、ドーム部１８ａの中心にばね２０の一端が固着されている。そしてばね２０の他端には負荷質量２１が慣性負荷として取付けられている。更にドーム部１８ａにはボイスコイルボビン１６が接着され、ボイスコイルボビン１６と振動板１８が一体にピストン運動するようになっている。負荷質量２１を振動系のマスとすると、ばね２０はコンプライアンスの機能を果たす。この場合のばね２０は蔓巻きばねとしている。

【００４２】負荷質量２１は平板状であり、フレーム１５の外周エッジと所定の間隔で空気の通路が確保されている。この通路は振動板１８の振動により音圧が発生したとき、加振器１０Ａの外部に音が放射されるようにした空気通路である。

【００４３】このように構成された実施の形態１の加振器１０Ａの動作について説明する。励振コイル１７に電気信号を印加されると、電磁駆動力が発生し、ボイスコイルボビン１６に結合された振動板１８が上下にピストン運動する。このとき、電磁駆動力の反力が生じ、可動部である振動板１８の加速度に比例して、固定部である磁気回路部とフレーム１５とに反力が伝達される。ヨーク１２、マグネット１３、センターポール１４とで構成される磁気回路部がこの反力により振動すると、その振動は被振動体１１にも伝わる。

【００４４】コンプライアンスとなるばね２０は、負荷質量２１に対してローパスフィルタとして作用する。励振コイル１７に印加された電気信号の周波数が音声周波数帯よりも低い場合は、振動板１８と負荷質量２１は一

体となって動作する。このため加振器１０Ａの最低共振周波数付近では共振鋭度が大きくなって、振動板１８の加速度も大きくなる。従ってこの反力が大きくなるので、加振器１０Ａは被振動体１１を振動させることができる。

【００４５】共振周波数に比較して印加する電気信号の周波数が高い場合（電話器等で使用される音声周波数帯）は、振動板１８と負荷質量２１はローパスフィルタであるばね２０によって機械的に分離される。この場合、振動エネルギーは負荷質量２１に伝達されないので、振動板１８は大きく振動する。この振動板１８の振動によって音圧が生じ、その音圧は矢印ａのように通路から外部空間に放射される。この状態は所謂スピーカとしての動作であり、通常の音声周波数帯では加振器１０Ａが発音体として動作することとなる。

【００４６】次に本発明の実施の形態１（その２）における加振器について図２を参照しながら説明する。図２は本実施の形態の加振器１０Ｂの構造を示す断面図である。なお、図１に示す加振器１０Ａでは、磁気回路部を被振動体１１に取付けてあるが、本実施の形態では、図２に示すように負荷質量２１が被振動体１１に近接する向きに加振器１０Ｂを取付けている。加振器１０Ｂを構成する各部分は図１の加振器１０Ａと同一であるので、同一部分の説明は省略する。

【００４７】この加振器１０Ｂにおいてはフレーム１５の側面に第２の通路１５ａが設けられている。この通路１５ａは振動板１８の振動によって発生する音圧を外部に出力させる孔である。

【００４８】このような構成の加振器１０Ｂにおける低周波数の信号に対する振動と、音声周波数帯における音の発生の動作は、図１に示す構造の加振器１０Ａと同様である。即ち音声周波数の周波数の電気信号を印加すると、発音体として動作し、その音は通路１５ａを通して外部に放射される。又音声周波数よりも低い周波数の電気信号を印加すると、加振器として動作する。又、両方の電気信号を印加すると、加振器と発音体として同時に動作する。このように用途によって使用法を選択することができる。

【００４９】（実施の形態２）次に本発明の実施の形態２における加振器について図３を参照しながら説明する。図３は実施の形態２における加振器１０Ｃの構造を示す断面図である。なお、本実施の形態の加振器１０Ｃにおいて、固定部としてヨーク１２、マグネット１３、センターポール１４、フレーム１５を有し、可動部としてボイスコイルボビン１６、励振コイル１７、振動板１８を有していることは実施の形態１と同一である。

【００５０】振動板１８を第１の振動板とするなら、本実施の形態には第２の振動板２２が設けられている。振動板２２はフレーム１５に対し第２のエッジ２２ａにより振動自在に保持され、振動板１８が低周波で振動したとき、空室Ｃの空気を介して間接的に振動する振動板である。空室Ｃは振動板１８、２２とフレーム１５の側面によって囲まれた空間をいい、振動板２２に対してコンプライアンスの機能を果している。

【００５１】フレーム１５の底部に通路１５ｂが設けられている。この通路１５ｂは振動板１８の振動によって発生する下側空間における音圧を外部に出力させる孔である。この加振器１０Ｃは、ヨーク１２の底部を介して被振動体１１に取付けられている。

【００５２】このような構成の加振器１０Ｃの動作について説明する。励振コイル１７に電気信号を加えると、電磁駆動力が発生し、ボイスコイルボビン１６に結合された振動板１８が上下にピストン運動する。コンプライアンスである空室Ｃの空気は振動板２２に対して、音響的なローパスフィルタとして動作する。電気信号の周波数が音声周波数よりも低い場合は、振動板１８と空室Ｃを介して結合された振動板２２とは一体となって振動する。

【００５３】電気信号の周波数がこれより高く、音声周波数帯域の場合は、振動板１８と振動板２２は、ローパスフィルタである空室Ｃの空気によって音響的に分離される。このとき振動板１８のエネルギーは振動板２２に伝達されないので、振動板１８は大きく振動する。このとき振動板１８によって発生する音圧は矢印ｂのように通路１５ｂから外部に放射され、音が人に伝わる。このように音声周波数帯では加振器１０Ｃは発音体として動作する。

【００５４】更に本実施の形態では、振動板１８と振動板２２とが空室Ｃの空気を介して結合されるので、電気信号の周波数が低い場合は、振動板１８の面全体に振動板２２の質量が均一に加わる。このため、実施の形態１に比べて振動板１８の強度はそれ程強いものでなくてよい。従って振動板１８の材料と構造の選定の自由度が向上する。

【００５５】（実施の形態３）次に本発明の実施の形態３における加振器について図４を参照しながら説明する。図４は実施の形態３における加振器１０Ｄの構造を示す断面図である。なお、本実施の形態の加振器１０Ｄにおいて、固定部としてヨーク１２、マグネット１３、センターポール１４、フレーム１５を有し、可動部としてボイスコイルボビン１６、励振コイル１７、振動板１８を有していることは実施の形態１と同一である。

【００５６】本実施の形態における振動板１８のドーム部１８ａに、ばね２０の一端が取付けられている。そしてこのばね２０の他端にはてこ２３を介して負荷質量２４が振動自在に取付けられている。フレーム１５のエッジの一部に支点１５ｃがナイフエッジ状に形成されている。てこ２３は支点１５ｃで保持され、支点１５ｃからばね２０の取付部までの長さをｒ１とし、支点１５ｃから負荷質量２４の取付部までの長さをｒ２としたとき、

ｒ２／ｒ１を変成比とする機械的変成器である。この場合の力点は負荷質量２４の側にあり、作用点はばね２０の側にある。

【００５７】このような構成の加振器１０Ｄの動作について説明する。励振コイル１７に電気信号を加えると電磁駆動力が発生し、ボイスコイルボビン１６に結合された振動板１８が上下にピストン運動する。てこ２３は機械的な変成器として動作し、負荷質量２４の質量をｍとすると、（ｒ２／ｒ１）^{2} ×ｍがばね２０の負荷として作用する。

【００５８】コンプライアンスとなるばね２０は、てこ２３と負荷質量２４に対してローパスフィルタとして動作する。電気信号の周波数が音声周波数よりも低い場合は、負荷質量２４はてこ２３を介して振動板１８に結合されて一体に振動する。こうして加振器１０Ｄは被振動体１１を振動させる。

【００５９】電気信号の周波数がこれより高く、音声周波数帯域の場合は、振動板１８が負荷質量２４に対して、ローパスフィルタであるばね２０によって機械的に分離される。この場合、このとき振動板１８のエネルギーはてこ２３を介して負荷質量２４に伝達されないので、振動板１８は大きく振動する。振動板１８により発生する音圧は矢印ｃのように外部に放射される。こうして加振器１０Ｄは発音体として動作する。

【００６０】更に本実施の形態では、負荷質量２４をてこ２３を介してばね２０に結合させるので、負荷質量２４の質量ｍを変成比の２乗に反比例して小さくすることができる。このため加振器１０Ｄの重量を小さくすることができる。

【００６１】（実施の形態４）次に本発明の実施の形態４における加振器について図５を参照しながら説明する。図５は実施の形態４における加振器１０Ｅの構造を示す断面図である。なお、本実施の形態の加振器１０Ｅにおいて、固定部としてヨーク１２、マグネット１３、センターポール１４、第１のフレーム１５Ａを有し、可動部としてボイスコイルボビン１６、励振コイル１７、振動板１８を有していることは実施の形態１と同一である。

【００６２】本実施の形態の加振器１０Ｅには図３の実施の形態２と同様にして、振動板１８の背面の空気室を外部と連通させるため、フレーム１５Ａの底面に通路１５ｄが設けられている。一方、実施の形態２と異なり、フレーム１５Ａの上部に第２のフレーム１５Ｂが取付けられている。フレーム１５Ｂの上中央部は円筒状の開口部１５ｘが形成され、この部分に第２の振動板２５がエッジ２５ａを介して振動自在に取付けられている。こうして振動板１８とフレーム１５Ｂと振動板２５により囲まれた空間により、空室Ｃが形成されている。

【００６３】このように構成された加振器１０Ｅの動作について説明する。振動板１８の有効面積をＳ１とし、

振動板２５の面積をＳ２、質量をｍとする。励振コイル１７に電気信号を加えると、電磁駆動力が発生し、ボイスコイルボビン１６に結合された振動板１８が上下にピストン運動する。面積比（Ｓ１／Ｓ２）を１より大きくすることにより、音響的な変成器を構成することができる。この面積比を音響変成比と呼び、この比を２乗した値と振動板２５の質量ｍの乗算値を振動板１８から見た等価負荷という。

【００６４】コンプライアンスとなる空室Ｃの空気は、振動板２５に対して音響的なローパスフィルタとして作用する。電気信号の周波数が音声周波数よりも低い場合は、振動板２５は空室Ｃの空気を介して振動板１８と結合して一体に振動する。この場合は加振器１０Ｅは文字通り加振器として動作し、被振動体１１を振動させることができる。

【００６５】電気信号の周波数がこれより高く、音声周波数帯域の場合は、振動板１８と振動板２５とは、ローパスフィルタである空室Ｃの空気によって音響的に分離される。この場合、振動板１８は大きく振動し、これより発生する音圧は矢印ｄのように通路１５ｄから外部に放射される。このとき加振器１０Ｅは発音体として動作する。又、振動板１８と振動板２５とは空室Ｃの空気を介して結合されるため、振動板１８に対して等価的に（Ｓ１／Ｓ２）^{2} ×ｍ　の質量が加わる。このため実施の形態１の加振器１０Ａと比べて、振動板１８の強度をそれ程強くする必要はなくなる。従って振動板１８の材料と構造の選定の自由度が向上する。

【００６６】更に本実施の形態では、振動板２５と振動板１８とに所定の面積比をもたせることにより、振動板２５の質量を小さくすることができ、加振器全体の重量を小さくすることができる。又、実施の形態３の加振器１０Ｄと異なり、機械的な変成器であるてこを用いないため、加振器の製作が容易となる。又外部に負荷質量を設ける必要がないので、小型化に有利であり、被振動体１１にとりつける際のスペースファクターがよいといえる。

【００６７】（実施の形態５）次に本発明の実施の形態５における加振器について図６を参照しながら説明する。図６は実施の形態５における加振器１０Ｆの構造を示す断面図である。なお、本実施の形態の加振器１０Ｆにおいて、固定部としてヨーク１２、マグネット１３、センターポール１４、第１のフレーム１５Ａを有し、可動部としてボイスコイルボビン１６、励振コイル１７、振動板１８を有していることは実施の形態１と同一である。

【００６８】本実施の形態の加振器１０Ｆには図５の実施の形態４と同様にして、フレーム１５Ａの底面に通路１５ｄが設けられ、フレーム１５Ａの上部に第２のフレーム１５Ｂが取付けられている。そしてフレーム１５Ｂの上中央部は円筒状の開口部１５ｘが形成され、この部

分に第２の振動板２５がダンパーを介して振動自在に取付けられている。

【００６９】又図４の実施の形態３と同様にして、フレーム１５Ｂの上端の一部にナイフエッジ状の支点１５ｙが形成され、この支点１５ｙを中心にてこ２６が回動自在に取付けられている。てこ２６の一端はワイヤを介して振動板２５と結合され、てこ２６の他端には負荷質量２７が取付けられている。この場合もてこ２６は機械的変成器として作用し、力点は負荷質量２７の側にあり、作用点は振動板２５の側にある。一方、振動板１８とフレーム１５Ｂと振動板２５により囲まれた空間により、空室Ｃが形成されている。

【００７０】このように構成された加振器１０Ｆの動作について説明する。励振コイル１７に電気信号を加えると、電磁駆動力が発生し、ボイスコイルボビン１６に結合された振動板１８が上下にピストン運動する。てこ２６は機械的な変成器として動作する。支点１５ｙからワイヤの取付部までの長さをｒ１とし、支点１５ｙから負荷質量２７の取付部までの長さをｒ２としたとき、ｒ２／ｒ１を変成比とする変成器が構成されている。そして負荷質量２７の質量をｍとすると、$(ｒ２／ｒ１)^{2}\times$ｍが振動板２５の負荷として作用する。

【００７１】更に振動板２５に対する振動板１８の面積比を１より大きくすることにより、この部分でも音響的な変成器として動作する。振動板２５の質量と$(ｒ２／ｒ１)^{2}\times$ｍによる見かけ質量とが加算され、前述の音響変成比の２乗が乗算される。この値を総合見かけ質量と呼び、この値が空室Ｃの空気を介して振動板１８に作用する。コンプライアンスである空室Ｃの空気は、音響的なローパスフィルタとして動作する。電気信号の周波数が音声周波数よりも低い場合は、総合見かけ質量が振動板１８に結合されて一体に振動する。この場合は、加振器１０Ｆは文字通り加振器として動作し、被振動体１１を振動させる。

【００７２】電気信号の周波数がこれより高く、音声周波数帯域の場合は、振動板１８と総合見かけ質量とは、ローパスフィルタである空室Ｃの空気によって音響的に分離される。このとき振動板１８は大きく振動し、これより発生する音圧は矢印ｅのように通路１５ｄより外部に放射される。この場合、加振器１０Ｆは発音体として動作する。又、振動板１８と振動板２５とは空室Ｃの空気を介して結合され、均一に総合見かけ質量が振動板１８の上面全体に加わるため、振動板１８の強度を特に考慮する必要はなくなる。従って、振動板１８の材料と構造の選定の自由度が向上する。又振動板１５と振動板１８による音響変成比を利用して、加振器全体の質量を小さくすることができる。

【００７３】更に本実施の形態の加振器１０Ｆでは、負荷質量２７をてこ２６を用いて結合する機械的な変成器と、振動板１８と振動板２５との面積比で構成される音響的な変成器との２つを利用している。このため振動板２５のトータルの質量を更に軽くすることができる。従って加振器全体の重量を実施の形態４のものよりも一層軽くすることができる。

【００７４】（実施の形態６）次に本発明の実施の形態６における加振器について図７を参照しながら説明する。図７は実施の形態６における加振器１０Ｇの構造を示す断面図である。なお、本実施の形態の加振器１０Ｇにおいて、固定部としてヨーク１２、マグネット１３、センターポール１４、第１のフレーム１５Ａを有し、可動部としてボイスコイルボビン１６、励振コイル１７、振動板１８を有していることは実施の形態１と同一である。

【００７５】更に本実施の形態の加振器１０Ｇには図６の実施の形態５と同様に、第１のフレーム１５Ａの底面に通路１５ｄが設けられ、フレーム１５Ａの上部に第２のフレーム１５Ｂが取付けられている。そしてフレーム１５Ｂの上部は円筒状の開口部１５ｘが形成され、この部分に第２の振動板２５がダンパーを介して振動自在に取付けられている。

【００７６】これまでの実施の形態と異なり、第１のフレーム１５Ａの下部に第３のフレーム１５Ｃを取付ける。このフレーム１５Ｃはヨーク１２の外周部とフレーム１５Ａの下端部で形成される環状の空間を外部と遮蔽し、第２の空室Ｃ２を形成する働きをする。そしてフレーム１５Ｃの外周部に音響共鳴管２８（以下、単に管と呼ぶ）を取付ける。この空室Ｃ２と管２８で音響共鳴器を構成する。

【００７７】このように構成された加振器１０Ｇの動作について説明する。励振コイル１７に電気信号を加えると、電磁駆動力が発生し、ボイスコイルボビン１６に結合された振動板１８が上下にピストン運動する。実施の形態４と同様にして、振動板１８と振動板２５は、所定の面積比を持たせることにより音響的な変成器として動作する。この音響変成比が振動板２５の質量に乗算されて、空室Ｃ１の負荷となる。空室Ｃ１の空気は振動板２５に対して音響的なローパスフィルタとして動作する。電気信号の周波数が音声周波数よりも低い場合は、振動板２５が振動板１８に結合されて動作する。この場合、加振器１０Ｇは文字通り加振器として動作し、被振動体１１を振動させる。電気信号の周波数が音声周波数よりも高い場合は、振動板１８は振動板２５と音響的に分離され大きく振動する。

【００７８】更に本実施の形態では、振動板１８の振動により発生する音圧が、矢印ｆに示すように、通路１５ｄを経て空室Ｃ２と管２８で構成される音響共鳴器に導かれる。このため加振器１０Ｇを発音体として動作させる場合に、音響共鳴器の共鳴現象によって音圧レベルは増大され、より大きな音響再生が可能となる。

【００７９】（実施の形態７）次に本発明の実施の形態

７における加振装置について図８～図１０を参照しながら説明する。図８は本実施の形態の加振器１０と、加振器１０を加振モードで駆動する電気信号発生装置３０及び音響信号生成回路３１との接続図である。加振器１０は実施の形態１～６で示した加振器であり、電気信号発生装置３０で発生する加振信号が加振器１０に入力されて動作するものとする。

【００８０】加振器１０の磁気回路部で発生する反力は、機械的な最低共振周波数foで最大となる。そしてこの周波数帯域の近辺で最も大きく被振動体１１を加振することができる。従って、電気信号発生装置３０によって図９に示すように最低共振周波数foを中心とする所定の帯域幅を持った電気信号を発生させる。そしてこの信号を加振器１０に入力することにより、加振器１０の量産時において最低共振周波数foにばらつきがあった場合でも、目標とする加振力を得ることができる。

【００８１】周波数帯域幅を持った電気信号としては、図１０に示すように正弦波信号を用い、加振器の最低周波数foを含む範囲で、時間的に周波数が掃引される信号とするならば、掃引周波数が最低共振周波数foと一致した瞬間に、加振器１０の磁気回路部で発生する反力は最大となる。そして、この周波数で最も大きく被振動体１１を加振することができる。なお、掃引の方向は、周波数の低い方から高い方あるいは、高い方から低い方どちらでも同様の効果が得られるものである。又、正弦波の波形は、一つの周波数の一周期が終了すると次の周波数の一周期に連続的につながる波形であっても、あるいは、周期が時間と共に連続的に変化する波形であってもよい。掃引は複数回連続的に行い、１～２秒の休止後、再度複数回の掃引をするほうが、例えば携帯電話に用いた場合、人体には大きな触覚の変化として感じるのでより望ましい。

【００８２】図１１は電気信号発生装置４０の他の例を示す回路図である。本図において４１は矩形波信号発生回路であり、その出力はトランジスタ４２から成るスイッチング回路に入力される。４３，４４はスイッチング用トランジスタ４２のバイアス用抵抗、４５はバッテリーである。この電気信号発生装置４０は矩形波発生回路４１より矩形波信号がトランジスタ４２に入力されると、電圧Ｖin（Ｖ）でトランジスタ４２はＯＮ状態になり、出力端には出力電圧Ｖout が発生する。次に入力波形が０（Ｖ）となると、トランジスタ４２はＯＦＦ状態となり、出力波形も０（Ｖ）となる。従って矩形波信号を時間的に周期が掃引される矩形波信号とするならば、出力波形も周期が掃引された信号となり、この信号を加振器１０に加えれば、掃引周期が最低共振周波数foと一致した瞬間に、加振器１０の磁気回路部で発生する反力は最大となる。そしてこの周波数で最も大きく被振動体１１を加振することができる。この作用は図１０の正弦波信号の場合と同様であるが、携帯電話などの移動体通信用の端末のバッテリーを電源としているため、バッテリー電圧のＯＮ－ＯＦＦで加振器の駆動信号が容易に作れるという特徴があり、より実用的である。

【００８３】尚、本実施の形態ではトランジスタ４２への入力信号は矩形波としたが、正弦波としてもよい。この場合もトランジスタ４２はＯＮ－ＯＦＦ動作をして、矩形波の出力信号を発生させることができる。

【００８４】加振器１０は低周波域で振動と音声周波数帯域で発音をするが、低周波の矩形波信号で振動させると、矩形波の持つ高調波の周波数成分のため、振動と共に大きな音が発生する。この高調波成分による発音は歪んだものとなるため、高調波成分は電気的にカットすることが望ましい。図１２はこのための回路を示すもので、４０が矩形波をする電気信号発生装置、５１がローパスフィルタ（ＬＰＦ）、５２が信号切換スイッチである。電気信号発生装置４０は図示しない制御信号が入力されると、矩形波信号を発生する。ここでは表示しないが信号切換スイッチ５２は入力信号に連動して切換わるものであり、振動させるときには、ローパスフィルタ５１側に接続される。ローパスフィルタ５１は矩形波信号が含む高調波成分をカットするものであり、加振器１０には高調波成分を含まない電気信号が入力され、振動の動作時に、歪み音が再生されるのを防止する。又、音の再生時には、信号切換スイッチ５２が切換わって音響信号生成回路３１の出力が直接加振器10に接続され、ローパスフィルタ５１の影響のない再生が可能となる。尚、ローパスフィルタ５１の高域遮断周波数は人の聴覚感度の比較的低い１５０～２００Ｈｚ以下が望ましい。

【００８５】又、本実施の形態では加振器の振動再生用として加える信号は、正弦波あるいは矩形波であったが、振動の共振周波数を含むものであれば、例えば周波数帯域幅を持つランダムノイズ信号、あるいは音楽信号等でもよい。

【００８６】（実施の形態８）次に本発明の実施の形態８における携帯端末装置について図１３を参照しながら説明する。図１３は携帯端末装置の構造を示す断面図である。携帯端末装置が携帯電話とすると、筐体６１、図示しない送受信回路、音声入出力回路、キー入力回路等を含んで構成される。ここでは携帯電話の着信を音ではなく、筐体６１の振動により利用者に伝えるものとする。このため筐体６１の一部に実施の形態１～７の加振器１０を取付ける。本実施の形態の加振器１０は前述したように加振と音声出力を行うものである。筐体６１に開口部６１ａを設け、この開口部６１ａから加振器１０の音声を放射する。

【００８７】加振器１０に音声周波数よりも低い周波数の電気信号を加えると、加振器１０の振動がフレーム１５を介して筐体６１に伝達される。利用者がこの携帯端末装置を衣服のポケットなどに入れて所持している場合、筐体６１の振動を身体で感じるとることができる。

一方、音声周波数の電気信号を加えると、加振器１０は発音体として動作し、匡体６１の外部に矢印ｇのように開口６１ａを通して着信音声が外部に出力される。

【００８８】従来の携帯電話では、加振器と発音体とは別個の部品で構成していたが、本発明の加振器を用いることにより、加振と発音との動作を共に行うことができる。このため携帯端末装置の小型化と軽量化とを実現すると共に、部品点数の削減による低価格化が可能となる。

【００８９】なお図１３では携帯端末装置としては携帯電話を例にしたが、ページャなど、その他の携帯端末装置に使用しても同等の機能が得られることはいうまでもない。又、本実施の形態では、携帯端末装置に取付けられた加振器に入力する電気信号について述べていないが、図８，９，１０，１１，１２で述べた電気信号発生装置３０，４０により駆動されることが望ましいのは言うまでもない。更に、取付ける機器も携帯端末装置に限定するものでなく、振動と音の再生を必要とする種々の機器、例えばオーディオ機器，ゲーム機器に用いてもよい。

【００９０】

【発明の効果】以上のように請求項１～２３の発明によれば、第１の振動板にコンプライアンスを介して負荷質量又は第２の振動板を結合させる構造を設けることにより、励振コイルに発生する電磁反力を磁気回路部に伝えることができる。音声信号が入力された場合は、第１の振動板の振動は音として外部に放射される。音声周波数より低い加振用の信号が印加された場合、第１の振動板が振動すればコンプライアンスを介して負荷質量又は第２の振動板が一体に振動する。この場合は加振器として動作し、被振動体を振動させることができる。

【００９１】又従来は加振器とスピーカとの２つのユニットを設けたが、請求項２４，２５の発明によれば、このような加振器や加振装置を携帯端末装置に組み込むことにより、加振器と発音体とを一つにまとめることができる。このため携帯端末装置の小型化、軽量化が可能となり、部品点数の減少による低価格化が実現できる。この場合の振動は慣性負荷の弾性振動によって発生するので、エネルギー損失が少なくなる。このため、携帯端末装置の電池の稼働時間が長くなるという効果が生じる。

【図面の簡単な説明】

【図１】本発明の実施の形態１（その１）における加振器の構造を示す断面図である。

【図２】本発明の実施の形態１（その２）における加振器の構造を示す断面図である。

【図３】本発明の実施の形態２における加振器の構造を示す断面図である。

【図４】本発明の実施の形態３における加振器の構造を示す断面図である。

【図５】本発明の実施の形態４における加振器の構造を示す断面図である。

【図６】本発明の実施の形態５における加振器の構造を示す断面図である。

【図７】本発明の実施の形態６における加振器の構造を示す断面図である。

【図８】本発明の実施の形態７における加振装置を示すブロック図である。

【図９】本発明の実施の形態７における加振信号の周波数特性図である。

【図１０】本発明の実施の形態７における加振信号の波形図である。

【図１１】本発明の実施の形態７における電気信号発生装置の回路図である。

【図１２】本発明の実施の形態７における加振装置のブロック図である。

【図１３】本発明の実施の形態８における携帯端末装置の構造を示す断面図である。

【図１４】従来の加振器の１つである動電型変換器の構造を示す断面図である。

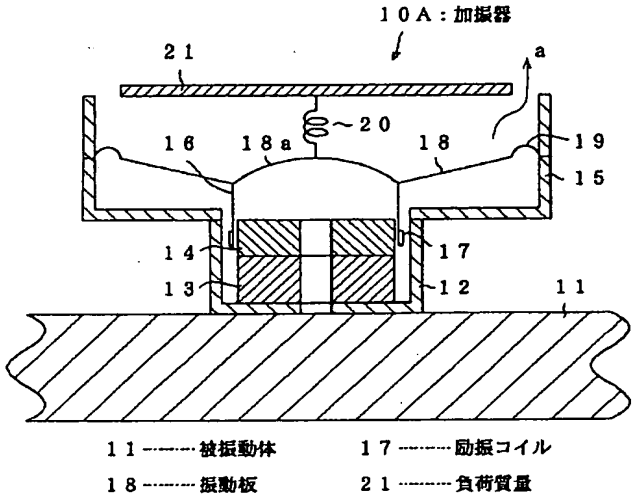
【符号の説明】

１０，１０Ａ～１０Ｇ　加振器
１１　被振動体
１２　ヨーク
１３　マグネット
１４　センターポール
１５　フレーム
１５ａ，１５ｂ，１５ｄ　通路
１５ｃ，１５ｙ　支点
１５ｘ，３１ａ　開口部
１５Ａ　第１のフレーム
１５Ｂ　第２のフレーム
１５Ｃ　第３のフレーム
１６　ボイスコイルボビン
１７　励振コイル
１８　振動板
１８ａ　ドーム部
１９　エッジ
２０　ばね
２１，２４，２７　負荷質量
２２，２５　第２の振動板
２２ａ，２５ａ　第２のエッジ
２３，２６　てこ
２４　第２のフレーム
２９　第３のフレーム
２８　管（音響共鳴管）
３０，４０　電気信号発生装置
３１　音響信号生成回路
４１　矩形波信号発生回路
５１　ローパスフィルタ
５２　信号切換スイッチ

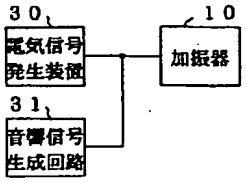
21　　22

６１　携帯電話の匡体　　＊　＊Ｃ，Ｃ１，Ｃ２　空室

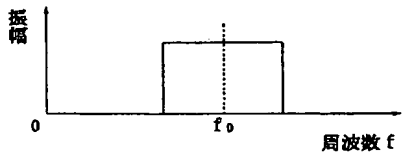
【図１】



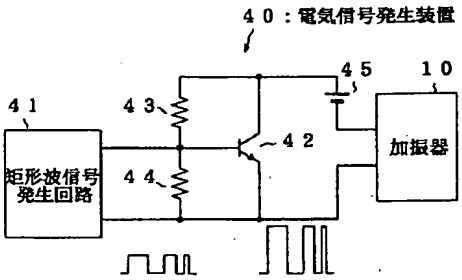
【図８】



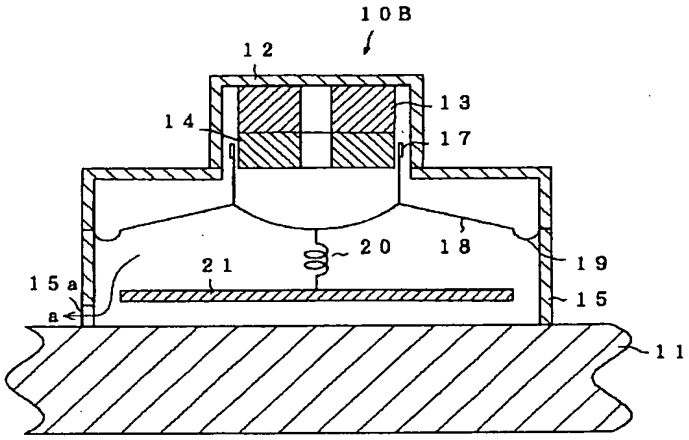
【図９】



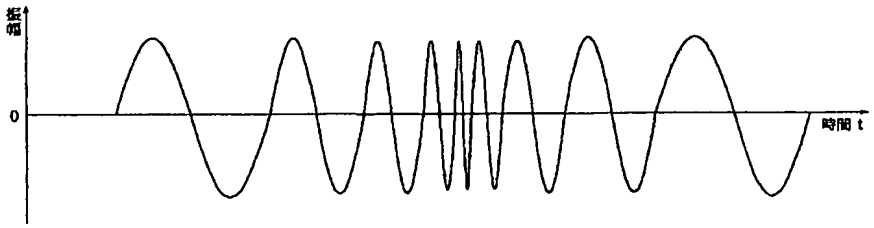
【図１１】



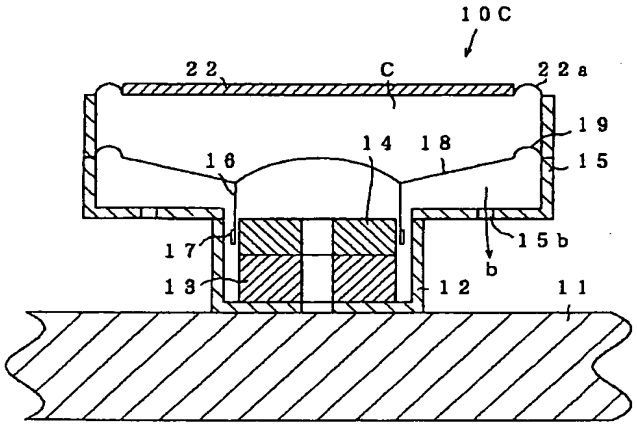
【図２】



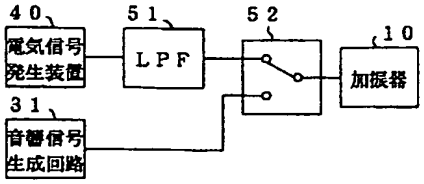
【図１０】



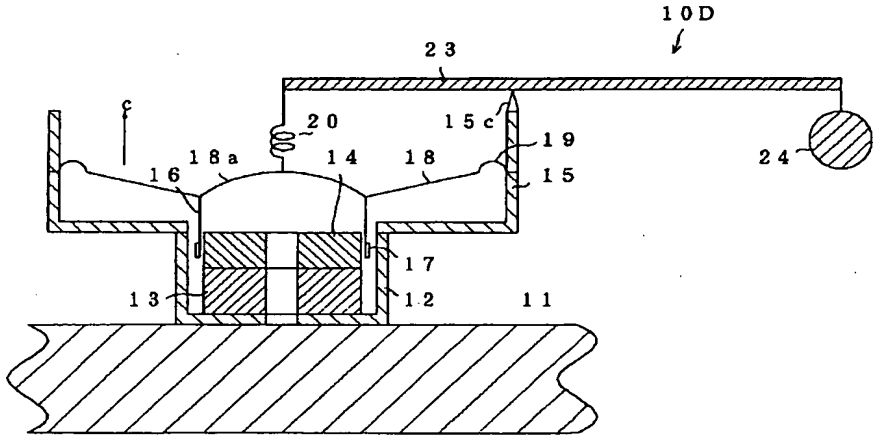
【図3】


10C
22
C
22a
19
14
18
16
15
17
15b
b
13
12
11

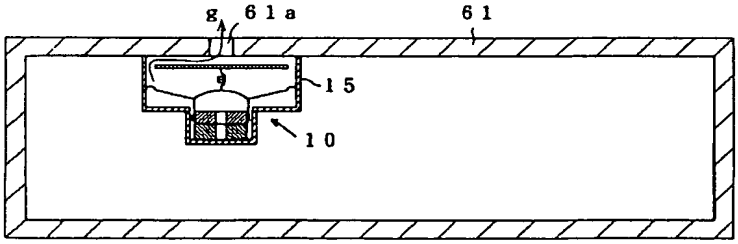
【図12】


40
51
52
10
電気信号
発生装置
LPF
加振器
31
音響信号
生成回路

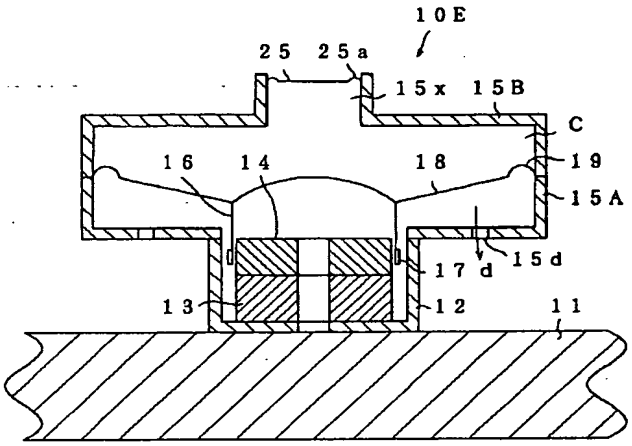
【図4】


10D
23
c
20
15c
19
24
18a
14
18
16
15
17
13
12
11

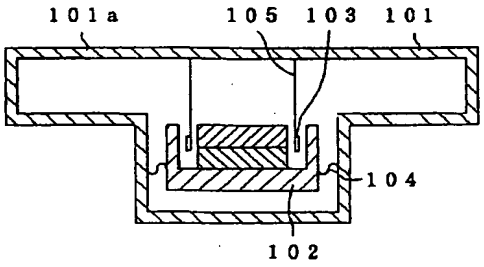
【図13】


g
61a
61
15
10

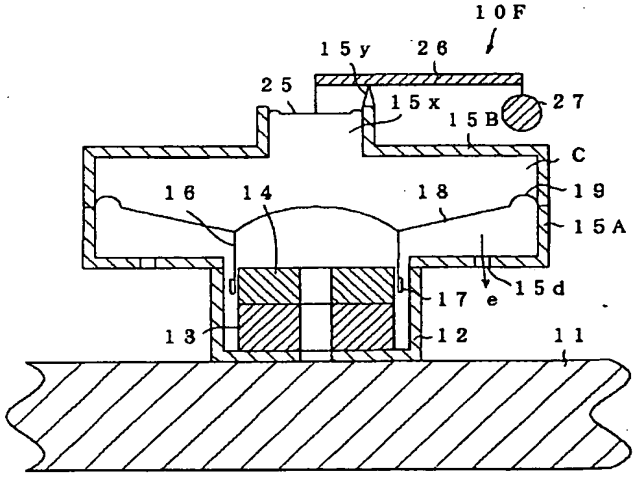
【図５】


10E
25
25a
15x
15B
C
16
14
18
19
15A
17d
15d
13
12
11

【図１４】


101a
105
103
101
104
102

【図６】


10F
15y
26
25
15x
15B
27
C
16
14
18
19
15A
17e
15d
13
12
11

【図７】